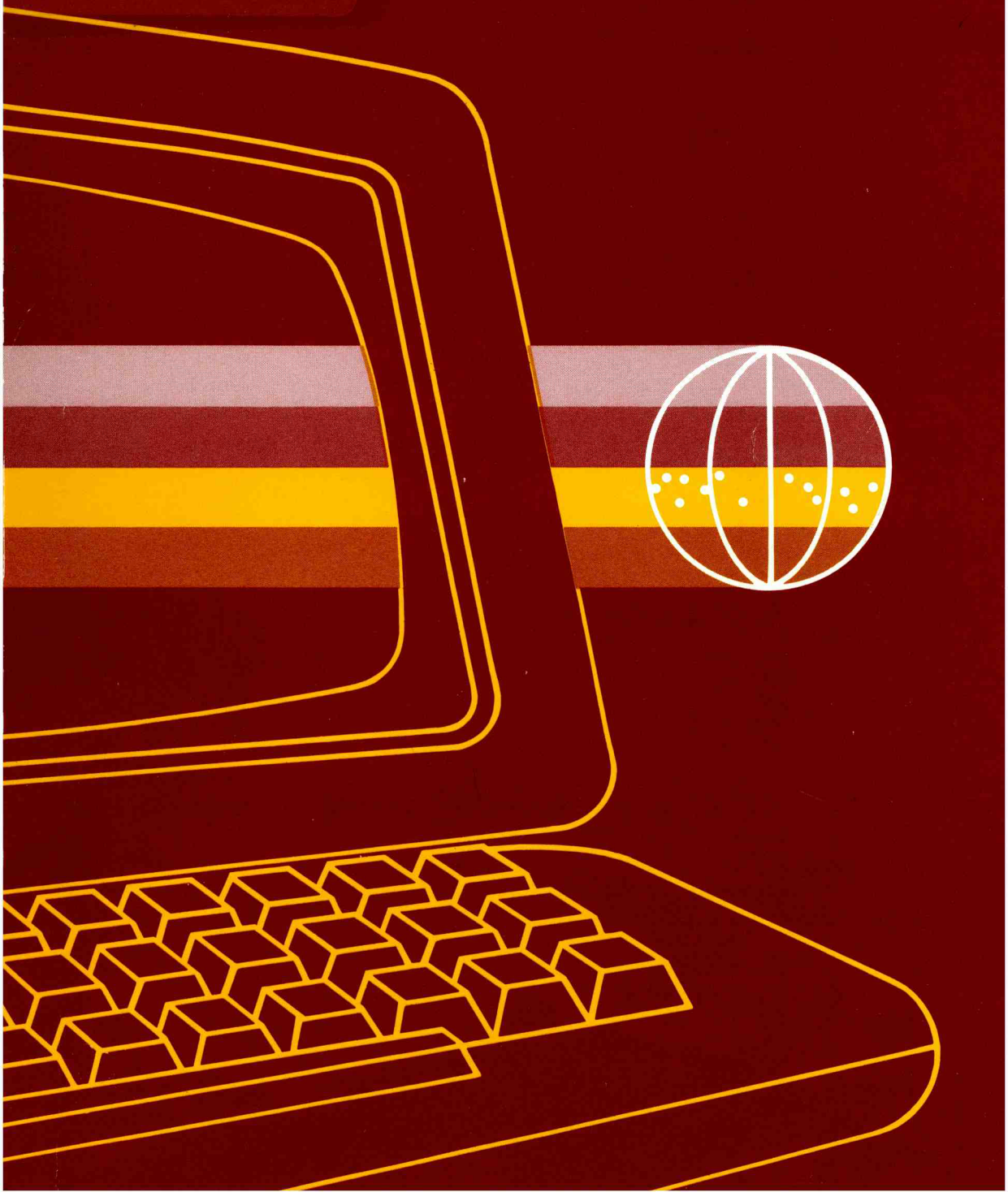
IDRC-241e

ternational Compute erence n Biotechnology: A Co



The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre's activity is concentrated in five sectors: health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Parliament of Canada; its policies, however, are set by an international Board of Governors. The Centre's headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa, Canada

Balson, D.A.
IDRC, Ottawa CA

IDRC-241e

International computer-based conference on biotechnology : a case study. Ottawa, Ont., IDRC, 1985. 103 p.

/Computer conferencing/, /data transmission/, /access to information/, /biology/, /engineering/, /systems analysis/ — /information users/, /technical aspects/, /content analysis/, /communication/, /evaluation/, /technology transfer/ , /developing countries/.

UDC: 621.39:681.3:547.458 ISBN: 0-88936-445-1

Microfiche edition available

Il existe également une édition française de cette publication.

IDRC-241e

International Computer-Based Conference on Biotechnology

A Case Study

Editor: D.A. Balson

Supported by the
International Development Research Centre
United Nations University
National Research Council of Canada
Board on Science and Technology for International Development
and the
Sven and Dagmar Salén Foundation

Abstract

An international computer conference on the bioconversion of lignocellulosics for fuel, fodder, and food took place from May to December 1983. It was initiated to evaluate the appropriateness of using computer conferencing to facilitate scientific discussions and to explore the application of the subject matter to development purposes. Individuals intimately involved in the organization and evaluation of this activity contributed chapters documenting the background, organization, operation, evaluation, and results. These chapters reflect the personal views of the authors, allowing the reader to view the activity from a number of different perspectives.

Generally, the technique of computer conferencing was accepted by this user group as a viable medium for facilitating scientific research. Although the industrialized-country researchers did not find the content of the discussions very valuable, the developing-country researchers found it extremely pertinent and appropriate. The most important outcome of this activity, however, was its contribution to the body of knowledge concerning the use of this technique in the facilitation of cooperative research activities.

Résumé

De mai à décembre 1983 s'est tenue une téléconférence informatisée internationale sur la bioconversion de matières lignocellulolytiques en combustible, fourrage et nourriture. Elle avait pour objet de déterminer le bien-fondé de l'utilisation de la téléconférence pour faciliter les discussions entre scientifiques et d'étudier l'utilisation de ce mécanisme à des fins de développement. Les personnes chargées de l'organisation et de l'évaluation de cette activité ont rédigé des documents sur l'origine, l'organisation, le fonctionnement, l'évaluation et les résultats de la téléconférence. Chaque document reflète les idées et opinions de son auteur, ce qui permet au lecteur de regarder cette activité à partir de différents points de vue.

Les participants ont reconnu, de façon générale, l'utilité de la téléconférence informatisée pour la recherche scientifique. Bien que les chercheurs des pays industrialisés aient jugé peu intéressants les sujets traités, les chercheurs des pays en développement, pour leur part, les ont trouvés très pertinents. Cette activité aura eu pour principal mérite de contribuer à l'approfondissement des connaissances sur l'utilité des téléconférences dans la promotion des activités de recherche en collaboration.

Resumen

De mayo a diciembre de 1983 se celebró una conferencia internacional computarizada destinada a analizar temas relativos a la bioconversión de lignocelulosa en combustible, pienso y alimentos para el ser humano. La conferencia evaluó la conveniencia de la utilización de las conferencias computarizadas para facilitar las discusiones científicas y para explorar la aplicación de los temas discutidos a los esfuerzos de desarrollo. Los expertos que participaron en la organización y evaluación de esta actividad contribueryon capítulos sobre antecedentes, organización, operación, evaluación y resultados. Los mismos reflejan las opiniones personales de los autores y ofrecen diferentes puntos de vista sobre estas actividades.

En términos generales, este grupo de usuarios opinó que la técnica de conferencias computarizadas resulta un medio viable para facilitar la investigación científica. Los investigadores de los paises industrializados no consideraron muy valioso el contenido de estas discusiones; sin embargo, los investigadores de los paises en vias de desarrollo estimaron que los temas tratados fueron pertinentes y apropiados. Esta actividad contribuyó sobre todo a aumentar el caudal de conocimientos relativos al empleo de esta técnica para facilitar la colaboración en las actividades de investigación.

Contents

Preface

Being aware of the rapidly increasing interest within the industrialized world in novel communication techniques, such as computer conferencing and messaging, several years ago the International Development Research Centre (IDRC) initiated a small program in the area of telecommunication systems. The Information Sciences Division of IDRC was concerned that developing-country institutions and individuals should have the opportunity to participate in the use, testing, and development of these systems so that *they* could judge the appropriateness of these tools for their own needs. At the same time, their involvement could be beneficial to the development of the field as a whole.

We entered into the computer conference on bioconversion of lignocellulosics with the foregoing in mind. We realized that new ground was being broken in the use of a relatively new communications technique on an international scale, by a group of scientists with very little experience with the technology, and in a telecommunications environment that made access for many very difficult. However, this experiment was looked upon as a learning experience for everyone involved. The report that follows documents the wealth of information gained through the evaluation and analysis of this activity.

The telecommunications environment is improving steadily. The international data transmission network is expanding, telex interfaces to computer-based systems are now available, and innovative methods of using packet-radio technology and satellites are being developed. As a result, the possibility of broader and more effective participation in computer conferencing and messaging activities in the future exists. The challenge remains to capitalize on the opportunities, as they present themselves, to facilitate the use of these communication techniques to bring the global scientific research community closer together.

Martha B. Stone
Director
Information Sciences Division
International Development Research Centre

Acknowledgments

Acknowledgment is given to those organizations that provided the funding to allow this exercise to take place: the International Development Research Centre, the United Nations University, the National Research Council of Canada, the Board on Science and Technology for International Development, and the Sven and Dagmar Salén Foundation. Special thanks is given to those individuals on the organizing committees who contributed their valuable time and energy. Assistance and advice from Jacob Palme, of the COM conferencing system and Murray Turoff and staff, of the Electronic Information Exchange System (EIES), was greatly appreciated. Finally, thanks goes to all those scientists who participated in this conference as well as to the various institutions that facilitated their participation.

Executive Summary

From May to December 1983, an international computer-based conference on bioconversion of lignocellulosics for fuel, fodder, and food, the subject of this publication, was carried out on the Electronic Information Exchange System (EIES) and COM computer-conferencing systems. Nine chapters reflecting the personal opinions of key individuals involved in this exercise were provided for this report. These individuals include the initiator of the idea, the overall organizer, the moderator on EIES, the evaluators, participants from a developing country, a donor/participant, and an individual with institutional interests. The personal contributions of these individuals are summarized below.

Historical Background

The World Academy of Art and Science provided the initial catalytic funding to allow Dr C.G. Hedén of the Karolinska Institutet to explore the possibility of applying the benefits inherent to computer conferencing to the support of research in the field of microbiology. With the acceleration of biotechnology research developments and the ever-growing gap between the resources available to industrialized- versus developing-country researchers, the need for linkages to support the free exchange of ideas and information among them was becoming increasingly obvious. A stepwise development to explore the possibilities seemed appropriate and began with the selection of a suitable topic: "bioconversion of lignocellulosics," with the subtitle, "for fuel, fodder, and food needed for rural development in poor countries."

Organization and Implementation

Following up on a recommendation from the workshop on Computer-Based Conferencing Systems for Developing Countries, held in Ottawa in 1981, and the stimulus of Dr C.G. Hedén, the International Development Research Centre (IDRC) began organizing a computer conference on this topic. The objectives of this exercise were to explore, on the scientific side, the possible uses of the bioconversion of lignocellulosics for development purposes and, on the technical side, to explore the viability of using computer conferencing to facilitate scientific research by a specific user group. Organizing committees were formed, moderators were selected, and EIES in New Jersey and COM in Stockholm were identified as the host systems. Funding support was secured from the National Research Council of Canada (NRC) (Ottawa), the Board on Science and Technology for International Development (Washington), the United Nations University (Tokyo), the Sven and Dagmar Salén Foundation (Stockholm), and IDRC (Ottawa).

More than 100 researchers from many countries took part in this open, 8-month conference with the majority, as expected, from industrialized countries. Off-line participation modes were provided for those unable to take part on-line. Participants took part on either EIES or COM, and texts were transferred between the two systems. The Scandinavian Organizing Committee concentrated on the organization of a concluding 5-day "dispersed workshop phase," while the Canadian Committee oversaw the general conference. Following the conclusion of the conference, extensive evaluations were carried out. It was found that the organizational inputs required for such a conference should not be underestimated.

Moderator's Viewpoint

To provide focus to the conference, five topic areas with brief descriptions were submitted for discussion. The moderator and five co-moderators had appropriate scientific and engineering expertise but little previous experience with computer conferencing. The conference was a qualified success. Participants in the developing countries found the conference more useful than those in the industrialized countries where a high expectation of new technical information generation was not realized. Participants were unwilling to share new unpublished results. After a slow start, a fairly high frequency of discussion took place among a significant number of the participants. The following additional points are made: (a) a simpler electronic mail system should have been tried before this more sophisticated one to allow the participants to develop rudimentary skills; (b) a brief face-to-face meeting between the participants should have been arranged shortly after commencement of the conference to allow some personal contact between them, a factor that is probably the driving force at conventional meetings; and (c) the co-moderators had relatively little input because of their other busy schedules and lack of incentives.

Evaluation of Participants' Experiences and Attitudes

Questionnaires were designed and mailed to all participants in the computer-based conference. The questionnaires for participants dealt with the scientific value of the conference and the value of the technology itself. Overall, the percentage return of the questionnaires sent to participants was 72% for a total of 97 completed questionnaires. Of these, 17 were from off-line participants. Only 4 of the 25 developing-country participants were able to participate on-line.

Seventy-five percent of the participants who responded to the questionnaire indicated that they would participate in a future computer conference on a topic of interest to them. The benefits of the conference that most encouraged their use of the system were that a written record of the conference would be made available and that the respondent could participate when convenient, learn new ways of communicating, and could think over responses before answering. There was agreement between the industrialized- and developing-country participants on these positive items. Thus, there was a high degree of acceptance of the technology as a valid method of scientific communication.

In contrast to the agreement of industrialized- and developing-country respondents on the benefits of the use of computer conferencing, major differences were found in the way these groups answered questions concerned with the problems that limited their use of the computer conferencing system. For the developing-country participants, difficulty with the telecommunication link was the factor most often reported as a problem. This was followed by difficulty with access to a terminal, higher priority for other activities, and cost of participation. In contrast, the industrialized-country participants were less bothered by technical difficulties and more concerned with the information. Their major problems were repetition in the comments, higher priority of other activities, unwillingness of other participants to share information, and lack of response to contributions.

Only 25% of those invited decided to participate in the conference. Accordingly, questionnaires were also sent to a sample of the nonparticipants to determine their reasons. Seventy percent of the developing-country questionnaires were returned, whereas 52% from the industrialized countries returned their questionnaires. For the developing-country respondents, the major reasons for not participating were costs, difficulties with the telecommunication link, problems with access to a terminal, and time constraints. For respondents from industrialized countries, the major concerns were time constraints, lack of face-to-face contact, costs, and difficulties with access to a terminal. Thus, lack of resources (including time, funds, and equipment) appears to be the major reason for not participating in the computer conference for both groups.

With regard to the scientific content of the conference, the comments and ratings indicated that many participants would like to see improvements in future computer conferences. They saw potential for the use of the technology but were concerned about low participation, low-quality comments, and a perceived lack of organization and focus. A review of the literature indicated that these problems are common in computer-based conferencing.

Funding agencies interested in advancing computer-based conferencing should take into account the following:

- Developing countries need to have improved access to telecommunication services and more terminals and funds to purchase computer time.
- Face-to-face meetings can be used to provide impetus for the conference. A face-to-face meeting of conference moderators to develop the introductory material and learn the conferencing system might encourage their involvement. Face-to-face discussions among some of the active participants, perhaps at dispersed locations as done in this conference, could provide further incentive and focus.
- Technical assistance in establishing the telecommunication link and teaching the scientists to use the conferencing system can be provided.
- The conference moderator(s) can be supported for his (their) work through release time and provision of clerical help.
- Finally, the conference should be widely advertised and the proceedings should be published.

Other recommendations that are not funding related include the following:

- Carefully select a computer conferencing system that is reliable, easy to use, and contains the facility for off-line editing and linkage to other sys-

tems. It should also provide for linked comments and subdivisions in the conference content.

- Establish ground rules concerning the moderator's powers and responsibility to edit the conference content. Participants should be involved in these decisions.

A Content Analysis of the Conference Proceedings

The contents of 574 texts entered into the EIES computer conference, "Bioconversion of Lignocellulosics," were analyzed. There were 327 texts that originated in the parallel conference "Bioconversion Technical" in the COM computer-conferencing system. The texts were labeled "scientific" if they were discussing the scientific conference topic, adding new information, or making conclusions based on old information of a scientific nature. Other texts were considered "nonscientific." The contents of each text were analyzed for type of contents, questions, answers to questions, and for the use of keywords (subject headers). About 50% of the texts were considered to be of a scientific nature.

The discussions seemed to be more focused on the scientific texts in the EIES conference than in the parallel COM conference. About 50% of the texts were commenting on other texts. One-fifth of the texts (about 90% of these were scientific texts) contained clear-cut questions. About 30% of the questions were answered. About 77% of the texts in the EIES conference and 60% of the texts in the COM conference had keywords corresponding to the actual contents of the texts.

The results from the analysis, and from comments received on a questionnaire on the scientific value, show that the conference was not a clear-cut success from a scientific point of view. The reasons for this, and the possibilities of enhancing the value of future scientific computer conferences, are discussed. Some possible impacts of this communication medium on the exchange of scientific information between the industrialized and the developing countries are commented upon.

Evaluation of the Communication Mode

From a technical perspective the bioconversion of lignocellulosics computer conference exercise must be considered a success with the host systems and communications networks largely meeting the participants' requirements. As was expected, the central technical problem proved to be the difficulty (or in some cases the impossibility) of gaining reliable access to the international data networks by scientists located in developing countries.

A number of general conclusions were derived from analysis of the technical aspects of this activity:

- The host systems and data networks were generally reliable and facilitated participation, except for the difficulties generally experienced by participants from developing countries.

- Expansion of access to international data networks from developing countries is essential if scientists in these countries are to be able to participate fully in future information exchange and transfer activities of this type.
- Equipment and facilities for participants (terminals, modems, microcomputers, software, communication links, etc.) must be close at hand if scientists are to integrate these activities into their normal research and scholarly communications process.
- Ready access to good support systems for participants (training, manuals, "colleague advisers," etc.) is essential to the successful application of computer conferencing to research communications in the future.

A Viewpoint from a Developing Country

To participate on-line, researchers at the Central American Research Institute for Industry (ICAITI) in Guatemala City had to overcome problems related to modems (standards), cables, and microcomputer communications software packages. Without local access to international data-transmission networks, on-line participation, when finally possible, was very expensive via regular voice channels. Despite these problems, these researchers believe that computer conferencing makes sense, especially in light of high travel costs, the scarcity of foreign currency and restrictions, and the future expansion of the international data-transmission web. On the scientific side, certain benefits accrued from participation in the computer conference: their knowledge of current research activities was updated, they discovered research activities in laboratories new to them, they received confirmation that their research was on track, and they found some of the scientific discussions interesting and useful. As scientists in developing countries, they see computer conferencing as an excellent tool for communicating ideas and exchanging know-how internationally.

If I Had My Druthers

From the standpoint of a participant and a donor, several recommendations are made: more technical support should be provided for inexperienced conferencing users, especially for those in developing countries; more effort should be given, in advance of future conferences, to getting participating scientists to use all the benefits of the technology including on-line retrieval, electronic messaging, and conferencing; and the management group of the conference should establish fluency in operating their own systems and the conference well in advance of the commencement of the public conference.

Future Directions

The experience gained in the bioconversion of lignocellulosics computer conference indicates a considerable potential in its use as a vehicle for technology transfer to developing countries. This is particularly so in the case of biotechnology where new knowledge is being developed extremely rapidly. The need to

transfer quickly new knowledge to scientists in developing countries to keep them current has to be recognized as an urgent matter. Networking arrangements are coming into being as a result of the efforts of the United Nations' agencies and the international nongovernmental organizations, and computer conferencing offers a means of rapid communication within these networks. It is recommended that a program that will permit developing countries to participate in computer conferencing be initiated as a priority consideration.

Introduction

Computer conferencing is a relatively recent method of communicating whereby any number of individuals can communicate on a one-to-one or a group basis using computer terminals, data-communication techniques, and a computer–host system. Unlike a face-to-face conference, where one speaks while the rest listen, with computer conferencing, participants, using terminals, type their comments, send them to specific files on the host computer, and read other participants' comments previously appended to those files. Because of its asynchronous nature, participants are able to communicate at a rate, time, and location of their own choice.

Research is increasingly being carried out in the area of biotechnology. One aspect of this subject, the bioconversion of lignocellulosics, may present developing countries with the opportunity to use underutilized resources (waste products) to produce fuel, fodder, and food. This being a possibility, it is imperative that research be carried out toward that goal both in the developing and in the industrialized countries.

Accordingly, from May to December 1983, a computer-based conference on bioconversion of lignocellulosics for fuel, fodder, and food was organized with two general objectives: to explore the possible uses of the bioconversion of lignocellulosics for development purposes, and to explore the viability of using computer conferencing to facilitate international scientific research by a specific user group. This report documents the background, organization, operation, and results of this computer conference. Individuals who played key roles in this exercise have contributed the various chapters that constitute this report. Each chapter reflects solely the personal views of its author and, as such, allows the reader to observe this exercise from a number of different perspectives.

Historical Background

C.G. Hedén[1]

In recent years, many governmental and nongovernmental organizations (NGOs) have taken initiatives aimed at bringing the potential of applied microbiology to bear on various problems in developing countries. An example is my own laboratory, which is one of the Microbiological Resource Centers (MIRCENs) that have been established by the International Cell Research Organization (ICRO) under the auspices of the United Nations Educational, Scientific and Cultural Organization (Unesco) and the United Nations Environment Programme (UNEP) (1). MIRCENs, specialized in biotechnology, biological nitrogen fixation, or culture-collection work, are located in developing countries such as Brazil, Egypt, Guatemala, Kenya, Senegal, and Thailand. However, there are also centres in some industrialized parts of the world: Sweden, Canada, Australia, Hawaii, U.K., and USA.

The overall emphasis is on research aimed at significant problem areas in poor countries, and every effort is made to help those scientists in rich countries who wish to support their colleagues overseas. The latter can for instance contact MICREN/Australia (the World Data Bank on Microorganisms, which is to be moved to Helsinki, Finland) when they need information on a particular strain, and other MIRCENs may guide them toward special advice on processes in which they might be interested.

In this connection, the need for an unambiguous digital exchange of information about the characteristic properties of microorganisms was noted early, so this became a natural focus of research of MIRCEN/Stockholm at the Karolinska Institutet. One of the reasons was that computers are now tools almost as essential to bioengineers as are fermentors. Another was that the Stockholm centre had been assigned a special responsibility for methods development, and this, of course, had to include network building. Because the initial efforts yielded solutions that were too expensive for network use (2), a close watch was kept on the sliding prices of computers and satellite services, and, at the same time, the hardware was simplified (3). Against this background, and constantly plagued by the difficulties of keeping in touch with our colleagues in developing countries by mail, MIRCEN/Stockholm followed the developments in computer conferencing with great interest (4, 5, 6) and growing enthusiasm about the opportunities that it seemed to offer:

- The reduced need to travel saves time and energy when many geographi-

[1]Microbiological Resource Centre, Karolinska Institutet, Box 60 400, S-104 01 Stockholm 60, Sweden. (This chapter is based on a paper entitled "A User Perspective on Computer Conferencing" presented by the author at a meeting of the Ottawa Chapter of the Canadian Association for Information Science on 11 January 1984.)

cally dispersed individuals need to carry out joint research projects or plan conferences.

- Rapid communication compared with mail.
- No time lost in trying to contact others by phone.
- Freedom to control time and frequency of communication means that ongoing work is not disrupted by travel or time-zone constraints.
- Access to private files and reprints as well as to local co-workers improves the message content, and the precision is improved by editing before transmission.
- No comments missed and "clocked" transcripts available as priority records or as widely distributed "instantaneous publications."
- Reduced risk for monopolized, prejudiced, or emotional discussions and greater opportunities for junior scientists to participate.
- Printed texts better understood than spoken, particularly when foreign words are involved or low-quality voice-lines must be used.
- The road is paved toward computer-assisted international team research, cooperative modeling, setting of standards, joint authorship, follow-up, and augmentation of face-to-face meetings, etc.
- Voting with immediate display, anonymous or private messages, computer-aided sorting, and other aids available to moderators/gatekeepers/program managers/rapporteurs and others.

Following the developments was easy because the military research establishment in Sweden had been one of the forerunners in the field when it designed a versatile and user-friendly system called COM (7). This had been made available to the Stockholm University Computing Centre, QZ, which operated a data network for scientific institutions all over Sweden. One of those was the Karolinska Institutet, which for many years has been quite active in the field of medical applications of computers. Their extensive bibliographic use for instance naturally turns the mind to the problem of making the information generally available as well to colleagues in the developing parts of the world.

However, there are still many barriers, ranging from a tendency of the power elite in developing countries to monopolize the sadly inadequate connections, to a lack of the funds that are needed to reach the multitude of data bases that are now accessible for instance through DIALOG and DIANE. One obvious way around such problems is of course to develop "information brokerage clubs" as important components of internationally funded joint research projects between many distant laboratories. Only one or two members of such teams would need to have data-base access, and by using computer conferencing, file transfers, and inexpensive microcomputers, some degree of independence from advanced communication systems ought to be within reach.

As a potential user, I was also impressed by the possibilities offered by such simple systems for establishing communication links between the components of various NGOs in which I had an interest (the officers and divisions of the World Academy of Art and Science (WAAS), the members of the International Federation of Institutes for Advanced Study (IFIAS), and the national affiliates to the Pugwash Movement). In this connection special mention should be made of WAAS, which very early noted the potential of computer conferencing and provided the initial catalytic funding that permitted MIRCEN/Stockholm to start exploring the field.

However, what actually pushed me from being an interested observer to becoming first a user and then a strong advocate of computer conferencing was actually the many breakthroughs in genetic engineering and biotechnology that have occurred in recent years (8). It was quite obvious that special efforts would be necessary if they were not to increase rather than decrease the gap between the rich and the poor countries (9).

This need for action was also noted by the United Nations Industrial Development Organization (UNIDO), which in 1981 proposed the establishment of an International Centre for Genetic Engineering and Biotechnology (ICGEB). This centre, which would provide advanced facilities for research and training of scientists from developing countries (10, 11), has now been the subject of discussion at a number of high-level meetings. Coordination of the activities of this centre with regional activities illustrates the need for effective telecommunication links.

Also, the subject matter is such that such links, serving as umbilical cords between returning trainees and the institutions where they were trained, will definitely be needed. This observation, which I made, while working as a consultant to UNIDO, reinforced an impression that I had gained earlier as a member of both UNEP/Unesco's advisory panel on microbiology and the grants committee of the International Foundation for Science (IFS): we normally give young scientists from developing countries an excellent training abroad, but we fail miserably in supporting them after they have returned home. This is probably where a well-developed system for computer conferencing could have significant impact.

Technology transfer must be associated with a systematic effort to develop a scientific and technical infrastructure. Otherwise a receiving country can never hope to achieve the level of self-reliance at which it can reap the full benefit of being sovereign. However, an efficient scientific and technical infrastructure is a culture rather than a particular mix of trained people and advanced equipment. At the core of this culture is a free exchange of ideas and information across disciplinary and bureaucratic boundaries, because this is where innovations have a tendency to crop up.

This is well illustrated by biotechnology, which can supply many examples that illustrate the following point made by G.P. Sweeney (12): "Innovation and technical progress happen through people who have the mastery of technology, a polyvalent skill, a technical culture which enables them to move across disciplines to understand the total process, and to make, combine and use physical things in a new way: a new way which is creative in all its aspects of design, materials and fitness for use."

In the industrialized parts of the world we benefit not only from efficient telephone and television channels but also from a multitude of other interfaces (popular scientific periodicals, exhibitions, and meetings of academies and research councils, etc.). Those interfaces all generate ideas, but they also teach individuals to filter and to use information. They learn to accept K.E. Boulding's thesis that knowledge must be gained through a loss of information, because only then can we hope to live and work according to Thomas Jefferson's "The end of all knowledge is action."

The major problems for inventors are the hierarchical barriers that surround them, because "the more you filter a new idea through the establishment, the

less chance it has to survive" (13). This worries many students of innovation, for instance W. Dujkhuis (14), who states that "we must much more decompartmentalize and liberate the presence of scientific and technical information in our organizational structures: and it seems that nothing less is needed for that than a full-fledged new professional and industrial culture."

If we regard this as a problem in the rich countries, think of the young scientist from a poor country who has been trained abroad and who returns to face the upgrading of a unique resource in his or her own country. Perhaps the processing of this special resource requires an innovative simultaneous use of another resource. Or a new method might have to be devised to circumvent the need for the expensive instruments that the scientist is accustomed to. Training in advanced laboratories does not prepare a young scientist for such ordeals, and knowledgeable colleagues might be thousands of miles away — if they are in the country at all, and not at some meeting on the other side of the globe.

This is the type of situation where computer conferencing/messaging might help to stimulate indigenous creativity. It would not only offer quick responses but also some protection against the "information overload" that may result from an uncritical use of data bases. It should not be forgotten that such overload may actually have an immobilizing effect on a young scientist, particularly when much of the published material is unavailable or might take months to receive. Joint research projects ought to neutralize such effects without jeopardizing the stimulus derived from browsing through data bases. The following quotations from a paper by P. Martin (15) underlines the importance of this process, which may well lead to something more valuable than what one looks for (16):

> Out of say 100 items retrieved from data bases perhaps 20% will be just what is being searched for and at least another 20% will be wild mis-hits where the words brought out peculiar items. But the other 60% are not exactly what was specified but have some degree of relevance.
>
> In practice, people who search not too precisely in an on-line data base get the area around that for which they are specifically looking, and this generates the ideas and knowledge which they then follow up.
>
> The idea of imagination and information working together to bring up new ideas is something which must happen there and then, it cannot wait for document delivery to bring up the idea . . .

There are many data bases that are of special relevance to developing countries, but a systematic effort to support their search for relevant information started only in 1973, when the International Development Research Centre (IDRC) in Ottawa acquired the Integrated Set of Information Systems (ISIS). However, this family of software packages was implemented on big IBM machines, so IDRC modified it for a minicomputer that was regarded as more appropriate for use in developing countries. This pioneering system, MINISIS, which now has over 100 licencees in different parts of the world, acts as a powerful driving force both for standardized indexing of development-related titles and for an exchange of relevant information.

When I was given the privilege of joining IDRC as a governor some years ago I was greatly impressed, not only by the farsighted initiative just mentioned but also by the Centre's excellent library service. However, I must admit that I was astonished to note that the use of those facilities, and particularly of MINISIS, for

scientific purposes, was not as much as I would have expected. Again I started to wonder if computer conferencing might not provide a means to marry the transdisciplinary "outlook" of MINISIS with the information needs at academic institutions. Within the framework of IDRC's cooperative program I saw many opportunities for Canadian experts to use this medium to support their colleagues in poor countries — who, in their turn, might open the eyes of their northern colleagues to challenging new problems. It was obvious that a stepwise development was needed so that various psychological, political, economic, and technical barriers could be defined and if possible eliminated before any major effort was considered.

We were certainly well aware of the rapid developments in satellite technology and other communication services when we started to plan for the computer-based conference on bioconversion of lignocellulosics for fuel, fodder, and food needed for rural development in poor countries. In view also of the trends toward networking in biotechnology, we consequently designed the experiment so that it would pave the way toward spinoffs, for instance, in the form of facilitation and extension of normal face-to-face meetings. This made us conclude the exercise with a "dispersed workshop" phase that could test the following points:

- The impact of technical failures can be minimized if experience is gained in an asynchronous preparatory conference.
- No limit to the number of participants, but the financial burden is split so that groups with small travel funds and limited operational budgets can participate in international activities.
- The challenge of rising travel costs can be met and more locations can be considered than those suitable for major international congresses.
- The need for interpreters is reduced and the opportunities for participation are increased if participating workshops use local languages but the text transmissions are in one language only.
- Computer-assisted panel sessions (CAPS) can be latched on to conventional congresses and symposiums.
- Many participants can speak and inject stimulating ideas at the same time without disrupting social contacts and interpersonal communications. Those can be very active in small face-to-face groups that also introduce an element of peer review.
- The conference structure can be flexible and planned to avoid overload through subgroups, associated telephone conferences, telex inputs, and circulation of texts at relevant international congresses.

First and foremost, we were convinced that the subject chosen, focusing on the major renewable material resource on this planet, would attract attention not only from experts but also from many of the U.N. and aid organizations that are active in this field. Second, it was an area with many opportunities for applications of the various recent breakthroughs in fermentation and enzyme technology and in genetic engineering, a fact that made it reasonable to predict the emergence of specialized subconferences and task forces. Third, the two areas where EIES and COM (the computer conferencing hosts selected) were widely used, i.e., North America and Scandinavia, also had strong research groups that could support the activities in the field chosen.

References

1. Lewis, C. 1983. Taming of the microbe. Development Forum, November/December.
2. Hedén, C.G. 1976. Instrumentation for the biochemical identification of microorganisms. In Norris, J. R., ed., Methods in microbiology. Academic Press, London, England.
3. Kuhn, I. 1982. Studies concerning the mixed populations of microorganisms. Mircen News 4, August.
4. Turoff, M. and Hiltz, S.R. 1978. The network nation: human communication via computer. Addison-Wesley, London, England.
5. Hiltz, S.R. and Turoff, M.1982. Human diversity and the choice of interface: a design challenge. Association for Computing Machinery, Special Interest Group on Social and Behavioral Science Computing (ACM Sig Soc) Bulletin, 13, 2–3 January 1982.
6. Licklider, J.C.R. 1982. Teleconferencing: working together with information across space and time. In Manassah, J.T., ed., Innovations in telecommunications, part B. Academic Press, London, England.
7. Palme, J. 1980. The COM computerized teleconferencing system Jan. 19th 1980 (revised April 20th 1980). Swedish National Defense Research Institute, S-10450 Stockholm. (For further information write Stockholm University Computing Center, QZ, P.O. Box 27322, S-10254 Stockholm, Sweden.)
8. Hedén, C.G. 1983. The future balance between biotechnology push and market pull. Paper given at a conference on: R&D strategies in a competitive environment, Montreal, October 2–5, 1983. (In press)
9. Hedén, C.G. 1982. Global aspects of biotechnology. Journal of Chemical Technology and Biotechnology, 32, 18–24.
10. Hedén, C.G. 1981. The potential impact of microbiology on developing countries. UNIDO/I.S.261.27, November 1981.
11. UNIDO (United Nations Industrial Development Organization). 1981. The establishment of an International Center for Genetic Engineering and Biotechnology, ICGEB. A report of a group of experts. UNIDO/IS.254. November 9th, 1981.
12. Sweeney, G.P. 1982. The industrial firm in the information society. In Sweeney, G.P., ed., Information and the transformation of society. North Holland Publishing Company, Amsterdam.
13. Aubert, J.E. 1980. The innovation process and the small firm — some new hypotheses emerging from an ongoing OECD study. Six-countries program, Limerick Workshop. Organisation for Economic Cooperation and Development (OECD), Paris, France.
14. Dujkhuis, W. 1982. Innovation: its evolution and present state. In Stern, B.T., ed., Information and innovation. North Holland Publishing Company, Amsterdam.
15. Martin, P. 1982 The innovative process and the online information channel. In Stern, B.T., ed., Information and innovation. North Holland Publishing Company, Amsterdam.
16. Laxman, R.K. 1982. Science smiles. IBH Publishing Company, Bombay, India.

Organization and Implementation

D.A. Balson[1]

The International Development Research Centre (IDRC) became involved in sponsoring this computer conference as a result of a workshop on Computer-Based Conferencing Systems for Developing Countries, which was held in Ottawa in October 1981. One of the recommendations of this workshop was that IDRC support a pilot computer conference, involving both developing and industrialized countries, on a topic such as lignocellulose research. Possible implementation strategies were examined in informal meetings by Carl-Goran Hedén, myself, and other interested IDRC staff through the first half of 1982. The identification of a moderator represented the first concrete step in the implementation process.

Professor Murray Moo Young of the Department of Chemical Engineering of the University of Waterloo accepted our invitation to be moderator for this proposed conference. To enhance the planning process the following individuals were also invited to join the Canadian Organizing Committee: Dr Stan Martin of the National Research Council of Canada, Dr Jack Saddler of Forintek Canada Corporation, Dr Dennis Howell of the Centre for International Programs of the University of Guelph, and Dr John Black of McLaughlin Library of the University of Guelph. Formal meetings of this group began in late 1982 and took place periodically throughout the course of the conference in 1983 and the evaluation and reporting phase in 1984. At times, this group of seven met and at other times it was augmented by interested individuals who became involved at later stages. Carl-Goran Hedén was the common thread between the Canadian Organizing Committee and a Scandinavian Organizing Committee that was struck early in 1983. This committee, which was chaired by professor Karl-Erik Eriksson of the Swedish Forest Products Research Laboratory, concentrated its activities on the concluding 5-day "dispersed workshop" phase of the pilot conference (12–16 December 1983).

Planning Phase

At our first formal meeting, the general topic of "Bioconversion of Lignocellulosics," with the subtitle "for Fuel, Fodder, and Food Needed for Rural Development in Poor Countries," was established. This was further broken down into five subtopics: Upstream Process Considerations, with Jack Saddler as a co-moderator; Processes for Food/Fodder, with Doug Cunningham of the University of Guelph as a co-moderator; Processes for Liquid Fuels, with G. Stewart of the

[1] Information Sciences Division, International Development Research Centre (IDRC), P.O. Box 8500, Ottawa, Ontario, Canada K1G 3H9.

Labatt Brewing Company Limited and D.G. MacDonald of the University of Saskatchewan as co-moderators; Processes for Gaseous Fuels, with J.M. Scharer of the University of Waterloo as a co-moderator; and General Considerations with Stan Martin as a co-moderator. Each of these subtopics was further divided into five areas, respectively, to assist in focusing the discussions.

The general objectives of this excerise were established as follows: on the scientific side, to explore the possible uses of the bioconversion of lignocellulosics for development purposes; on the technical side, to explore the viability of using computer conferencing to facilitate scientific research by a specific user group; and on a secondary level, to lay the groundwork for future application of this technique, on a global basis, to more specific aspects of the subject. From my own standpoint of being responsible for a program involving the support and facilitation of the use of data communication techniques in support of research in developing countries, I had two additional objectives: to increase awareness in general and to gain experience in the organization and operation of a computer conference on an international scale. Following an examination of a number of commercially available host systems, we selected the Electronic Information Exchange System (EIES) and COM to be the host conferencing systems for this event.

EIES is managed by the Computerized Conferencing and Communications Center under the direction of Murray Turoff, based at the New Jersey Institute of Technology in Newark, New Jersey. This system was chosen basically because of its reliability, its relative user-friendliness, its established nature, and its extensive network of existing users.

The Scandinavian Organizing Committee selected the COM conferencing system designed and developed by Jacob Palme and his colleagues first at the Swedish National Defense Research Institute and then at the Stockholm University Computer Centre (QZ). This system was chosen for use mainly for participants in Scandinavian and European countries but also for any other countries that could more easily or economically access the Swedish national data network than the EIES system. The COM system has enjoyed a very good reputation throughout Europe and Scandinavia and countries further afield.

At an early stage, funding for specific aspects of this conference was put in place by IDRC. This funding would cover the costs of participation of the principal participants from the Canadian Organizing Committee and of the co-moderators, the costs of participation of selected participants in developing countries both on-line and off-line (explanation of this aspect appears later in this chapter), the costs of transferring entries from EIES to COM and vice versa, and the costs of holding three meetings of the Canadian Organizing Committee (meetings of some members of this group were possible without funding).

As it turned out, this budget was not spent as planned. As the computer conference began to take shape, other organizations became interested and actively involved. The Energy Division of the National Research Council of Canada (NRC), which was interested in both the subject and the process, offered to support the costs of some of the key Canadian participants. The Board on Science and Technology for International Development of the U.S. National Academy of Science funded a project whereby three research teams in the United States and three teams in developing countries would participate in the confer-

ence and report on the results. Finally, the United Nations University, which was interested in exploring how this communication process could enhance its decentralized project-oriented operations, offered to fund an extensive evaluation of this activity. These additional sources of financing allowed the IDRC budget to cover such unbudgeted expenses as an evaluation design study and an expensive but useful experiment of access to EIES from Bangkok, Thailand.

The activities of the Scandinavian committee were managed by the United Nations Environment Programme (UNEP)/United Nations Educational, Scientific and Cultural Organization (Unesco)/International Cell Research Organization (ICRO) sponsored Microbiological Resource Center (MIRCEN) at Karolinska Institutet in Stockholm under a grant from the Sven and Dagmar Salén Foundation.

From the outset, we realized that the majority of the participants would be located in North America and Europe, because most of the research was taking place in these regions and access to equipment and data networks was both easier and more economical. At the same time, we wanted to encourage as much participation as possible by developing-country researchers to promote interactions between regions in this research area, to expose this technique to as wide a community as possible, and to learn more about the access difficulties that would be experienced by participants located in developing countries.

Realizing that many developing-country researchers would not be able to participate on-line because of problems such as lack of access to a terminal, the existence of legal or regulatory constraints on international data communications, excessive costs in accessing the nearest data transmission network, or all of the above, we established a procedure for off-line participation. Individuals in this category were mailed copies of the transcript of the computer conference on a monthly basis. They could then submit comments, questions, or messages via IDRC by mail or telex. Responses to their submissions were then received by the individual upon receipt of the next mailing of the transcript.

A set of potential participants was derived from the individual directories of contacts of the members of the Canadian and Scandinavian Organizing Committees, the participant lists of several recently held face-to-face conferences on related subjects, and the mailing lists of several organizations with mandates covering the biotechnology field. More than 500 individuals received an initial invitation package that included an invitation letter documenting the specifics of the computer conference, a description of computer conferencing, a mailing list of those individuals who were receiving the invitation, and a questionnaire inquiring whether the recipient was interested in participating and receiving more information and in naming any other individuals who might be interested.

To those persons who replied in the affirmative, a follow-up information package was sent. This information package included the following: the program format; the logistics of participating in the computer conference; the scope and aims of the conference; the topics and subtopics to be discussed; an overview of the general subject; short descriptions of the subtopics; the identification of EIES as the host system; a description of the account structure of EIES and respective costs; a User Guide, which was a condensed, easier to use version of the EIES Users' Manual that is sent to new users following account activation; advice on data communication protocol including lists of the public access telephone numbers for Datapac in Canada and Telenet in the United States; procedures for

activating one's account (I acted as an intermediary to facilitate the account activation process by requesting activation upon receipt of a telex or telephone request and then relaying the account number and password to the new user); and an explanation of the procedures for participating off-line for researchers in developing countries. Potential COM users received corresponding information and support packages from the Scandinavian committee.

Although we expected to initiate the computer conference in March of 1983, it did not actually commence until May. From our experience, one should expect at least a 6-month lead time from sending out invitations to active participation. Even though we initiated the conference 4 months after the invitation process began, significant participation did not occur until 2 months later.

Time delays occurred during the invitation and account activation stages with the use of postal systems. Delayed decisions to participate and minimal participation in the early stages (at least in this instance) because of a "wait and see" attitude being felt by many of the participants and hesitation by others while they became accustomed to a new technique of communicating, resulted in a later effective start-up date.

The following table provides a breakdown on the responses to the invitations (for participation on the EIES system only).

	Individuals in industrialized countries		Individuals in developing countries		Total	
	No.	% of all invitations	No.	% of all invitations	No.	% of all invitations
Invitations sent	461	100	80	100	541	100
Replies received	140	30.4	25	31.3	165	30.5
Affirmative replies	104	22.5	25	31.3	129	23.8
Response rate	30.5% (165 of 541 invited)					
Affirmative response rate	23.8% (129 of 541 invited)					

Asynchronous Computer Conference Phase

Not all of those individuals who expressed an interest in participating followed through with the necessary arrangements. The actual number of on-line accounts on EIES was 33. This represented about 107 researchers because some accounts were shared by groups of researchers. In addition, there were 23 off-line participants. The number of COM participants was also 23.

On both EIES and COM, one can establish conferences as either "public" (open to any individual who has access to the system) or "private" (open to only those users who have been given access by the moderator of that conference). The computer conference on bioconversion of lignocellulosics officially began on 2 May 1983 on the EIES system as public conference C604 — Bioconversion of Lignocellulosics. As each account was established a welcome message was sent informing the new user on how to access the specific conference. It was announced to the general EIES public through the EIES on-line newsletter, CHIMO, and in the conference listing of public conferences (C1008). Corresponding announcements were also made over the COM system.

A complementary private conference, Bioconversion CC Organization (C268), was established for communications among the two Organizing Committees and to facilitate the transfer of entries between EIES and COM. C268 was used minimally. A group was set up on EIES, BIOCON — G50, consisting of all participants in the public conference, with the purpose of sending administrative or nonsubject-oriented messages to all participants. Here again, this facility was used minimally until after the conference was concluded. At that time the membership of the group was reduced to consist of only those individuals in the expanded Canadian Organizing Committee (including the evaluators and representatives of funding agencies) and the group messaging technique was used effectively for facilitating the evaluation construction, meeting preparation, and follow-up report distribution and feedback. On COM, the conference was also split into a technical and an administrative component (Bioconversion Technical and Bioconversion Planning, respectively).

Instead of opening the conference with a discussion paper, we began with a welcome message to the participants from the President of IDRC, Ivan Head, and 11 comments introducing the aims and scope, program, and topics and subtopics including background and descriptions of the subtopics. We originally planned to run the conference for a 6-month period until the end of October, but due to the slow start, as previously explained, we extended the conference until the end of December 1983.

Running the conference on two host systems was a complicating factor. Initially, John Black, University of Guelph, handled the transfer of conference comments manually in both directions. This was a time-consuming and expensive task. Furthermore, decisions on what to transfer and what to leave behind can be difficult. In the latter stage of the conference, Jacob Palme, Stockholm University, handled the intersystem transfers using, in part, automated methods. Although publicity for this computer conference was not handled in a coordinated fashion, a number of subject-related journals and institutional newsletters ran periodic announcements about its progress.

During the course of the conference, the role of the overall organizer or coordinator consisted of multitudinous tasks. These included responding to requests from outsiders for information about the conference; inviting participation of newly identified potential participants; account activation and cancellation upon request; clarifying account problems especially related to billing; distributing extra user guides and manuals; disseminating monthly transcripts and updates and facilitating off-line participation; troubleshooting via telex, mail, and phone about log-on procedures; troubleshooting on-line about the use of the system and its special facilities; editing entries upon request (double entries, private messages entered as conference comments, mistakes within comments); entering 500-word summaries received by mail; consulting with moderators concerning overall plans and the timing of moderators' inputs; monitoring the discussion and the flow of communications; and organizing of face-to-face meetings.

Not all of these tasks need have been centralized. Individual participants could have been requested to handle their own arrangements. A number of participants involved in the organization could have had certain tasks designated to them. But, because this particular computer conference was the first of its kind in many ways with a relatively inexperienced user group, it was deemed appropri-

ate, to ensure better coordination, to have most of these duties looked after by a central body. The COM management was of a similar nature with the task of handling the day-to-day activities assigned to Mrs Francis Van Sant of the Karolinska Institutet, with Jacob Palme as the technical back-up expert.

The "Dispersed Workshop" Phase

It is well-known that psychological factors such as the feeling that "there is someone out there listening" are important for the success of a computer conference. In the course of asynchronous communication, extending over many months and involving a fairly small number of active participants, this puts a very severe load on convenors, moderators, and co-moderators who may even have to do literature searching to respond to questions that are outside their narrow fields of specialization.

An alternative approach, to create a sense of participation in a dynamic activity, is to concentrate the exchange of messages and comments to a limited period of time. Such an effort was made in December when the Scandinavian committee organized a concluding 5-day "dispersed workshop" on the computer-conferencing theme. This exercise involved participation from Manchester, Frankfurt, Stockholm, Moscow, Bangkok, Manila, Tokyo, Washington, and Ottawa. Those cities either acted as nodes for local networks or as locations for small 4-hour, face-to-face daily meetings. Moscow, for instance, served as a node for a network stretching from Leningrad to Kiev and from Tallin to Tashkent, and Frankfurt used telephone-conferencing to involve a number of bioengineers, dispersed by a beet-campaign, in the information exchange. The timing of the different inputs was chosen in such a way that a natural round-the-globe flow of information was achieved. Ottawa and Washington started their meetings at 0900 hours and Manchester, Frankfurt, and Stockholm followed at 1300 hours on Monday. Moscow, on the other hand, did not join the system until 0900 hours on Tuesday, followed by Bangkok, Manila, and Tokyo at 1300 hours. On Tuesday at 0900 and 1300 hours, the Ottawa/Washington and Manchester/Frankfurt/Stockholm groups entered their second round, and so on.

As illustrated by the participation in this phase, which in fact became so intense that a planned Delphi-study had to be cancelled, there is much to be said for the "dispersed workshop" as a supporting activity in the course of an extended asynchronous computer conference.

Evaluation and Report Phase

The initial plan for the evaluation of the computer conference involved three steps: obtain baseline data through a short questionnaire at the start of the exercise, obtain data for comparison purposes and analysis at the conclusion of the conference through a more extensive questionnaire (on-line), and evaluate the resulting transcript with respect to its scientific content. It became apparent, with the gradual increase in the number of participants and the small amount of participation through the early stages of the conference, that a new plan was required.

A three-pronged evaluation was planned with the collaboration and funding of the United Nations University (UNU). Jo Tombaugh, of the Department of Psychology of Carleton University, was identified to do an analysis on the social-psychological aspects of participation and to comment on possible technical improvements for facilitating networking with scientists in developing countries. Bjorn Olof Fabricius, of the Department of Microbiology of the University of Helsinki, was selected to evaluate the scientific content of the conference and to comment on the communication dynamics within the discussions. John Black was named to assess the technical aspects of access to the conference with special emphasis on the problems encountered by developing-country participants or potential participants.

A questionnaire to gather information useful to all the evaluators was constructed with inputs from the Organizing Committees, sample questionnaires from EIES, and a draft questionnaire produced by the UNU. Statistics on usage and costs were procured from EIES and COM. Other data were obtained from personal interviews and the transcript itself. This evaluation took place during the first half of 1984 and later chapters document the results.

Albeit that this exercise was undertaken on basically virgin ground, the implications for human resource requirements for organization and coordination should *not* be underestimated. Significant inputs are required. It is hoped that lessons learned from this experience, and documented in this report, will help to alleviate the organizational burden of any future undertaking of this nature.

Moderator's Viewpoint

Murray Moo-Young[1]

It was with some reservation that I accepted the invitation to serve as the overall moderator of this conference. On the positive side, the subject matter (preselected by C.G. Hedén, Stockholm) was of direct interest to my own research work and I was assured that I would receive assistance from a rapporteur and various session co-moderators; in addition, I was told that the conference would be primarily addressed to developing-country concerns for which I have deep empathy. On the negative side, it was not clear how the computer-based system would work because virtually all of the proposed participants had no previous experience with it; and, furthermore, I was skeptical as to the willingness of participants to share their research results without encouragement via the usual visual or aural contact. In the end, the challenge to experiment with a new electronic medium for communicating with research colleagues on topics of common interest was too attractive to refuse.

In this report, a personal view of the conference experiment is given. An outline of the program format and topics is followed by a presentation of the results and some recommendations. Separate reports, given elsewhere, give statistical analyses of questionnaire responses from participants. In particular, those reports deal with content analysis and participants' experiences. By contrast, this report addresses the perception and experience of the moderator.

The information is based on a limited group of participants. The overall profile of this group is as follows: Number of individual and group user id's = 172. Number of registered countries = 23, which included countries in North America, Europe, Africa, Australasia, and the Orient, but excluding several others (USSR, FRG, DDR, etc.), which participated via European "nodes" during a 1-week "dispersed workshop" phase toward the end of the conference. The number of developing countries that participated mostly off-line via telexes = 14.

Background to Conference

In recent years, there has been an increasing interest in electronic means of networking groups and individuals for technical information exchange or data base development. A computer-aided conferencing system offers several advantages over the more conventional conferences that require the actual meeting of participants or synchronous audio/visual communications. The net result is a reduction in travel costs and the possibility of ongoing interactions with various parts of the world, allowing convenient local hours for all participants. EIES

[1] Institute for Biotechnology Research, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1.

(Electronic Information Exchange System), operating out of a host computer in the New Jersey Institute of Technology, USA, was the system chosen because its features were considered to be user-friendly, especially for neophytes (1). Our European colleagues interfaced via the COM system and developing countries, for the most part, participated off-line via telexes and letters.

The conference addressed existing and potential uses of bioconversion processes for the production of fuels and animal or human foodstuffs from lignocellulosic materials. Various aspects of these processes (scientific, engineering, economic, social, etc.) were suggested for coverage. Discussion of and development of a data base of information on an area of biotechnology that is of current global interest and of particular relevance to problems in Third World countries were to be promoted. Unlike a conventional conference, there was no formal presentation of papers. In fact, it was intended to be more like the discussion, or "question and answer" period following the presentation of papers, interspersed with brief commentaries provided by the program moderator and co-moderators. As a basis for discussion, I prepared the following background material, which was supplied in advance to all participants. In my capacity as the overall conference moderator, I was allowed co-moderators for each of the five sessions discussed in the following sections. In addition, I personally conscripted one of my research assistants, Arlene Lamptey, to manage the numerous computer connections throughout the conference period. Without her help, my participation in the experiment would not have been possible.

Overview of Program Topics

Global depletion, especially in Third World countries, of fuel, fodder, and food commodities has led to current considerations of lignocellulosic bioconversion processes for producing these products. Lignocellulosic materials comprise the world's most abundant renewable resource having favourable distribution in many industrially poor countries that are generally blessed with the requisite photosynthetic power for their generation. The high carbohydrate content of lignocellulosics (up to 50% cellulose and 40% hemicelluloses) is attractive for bioconversion process strategies; compared to corresponding chemical routes, higher product yields and lower processing energy requirements are theoretically possible. Counteracting these encouraging scientific observations are some real-world techno-economic problems that remain to be resolved, e.g., the inherent slowness of bioconversion rates, especially with these recalcitrant materials, and the difficult materials handling of a noncentralized, low-density, bulk feedstock supply of basically forestry material (wood) and agricultural crop residues (straws, stovers, etc.).

Several literature reviews on this subject matter are available. Particular attention is drawn to a recent monograph (2) that includes an appendix on activities in developing countries. It was hoped that this reference, and the cross-references generated by it, would serve as a basis for initiating and maintaining most of the conference discussions. Some basic questions to be addressed included: What is the most attractive lignocellulosic material for a given process? What is the most efficient process for a given feedstock? What are the quality characteristics of the products and byproducts? What are the relevant analytical methods and instru-

mentations available? What are the socioeconomic possibilities of operating a given process on a small scale or in Third World countries with unsophisticated technology skills? What are the immediate, near-term, or long-term prospects for a given process? Where or from whom can more information on a particular topic be obtained? Classifications and highlights of the five areas to be discussed follow. By including a subtopic entitled "miscellaneous" in each of the five sessions, of which "general considerations" is one, discussion of virtually any aspect of the subject matter was possible.

(a) Upstream Process Considerations (Session Co-Moderator: J.N. Saddler, Ottawa)

In general, scientific researchers at the bench scale level often forget the importance of upstream or downstream processing costs or both. In the case of lignocellulosic bioconversion processes, these costs become prohibitive for most, if not all, of the newly proposed processes. Thus, there is a strong incentive to improve existing lignocellulosic pretreatment methods or to develop new, more efficient ones.

Chemical methods involving acids (mainly H_2SO_4), alkalis (mainly NaOH), and organic solvents (various candidates) suffer from low yields, primarily because of degradation products formation. Biological (mainly fungal) and enzymatic (mainly *Trichoderma viride* extracts) methods are too slow without chemical or physicochemical pretreatment. Most methods must be preceded by physical techniques (mainly crushing and grinding) to enable suitable mass or heat transfer rates of pretreatment fluids. Various effects are promoted by these methods (hydrolysis, delignification, depolymerization, decrystallization, comminution, swelling, etc.) to allow solid substrate accessibility or the formation of liquid substrates (glucose, xylose, etc.) or both. The search for effective catalysts (mainly inorganic) to enhance hydrolysis rates is intense. To minimize or avoid the necessity of pretreatment, the use of industrial waste residues (e.g., papermill pulp sludge, coffee grounds, sugarcane bagasse) is to be encouraged; in some cases, an extra credit for their utilization may be gained because of the concurrent environmental pollution abatement (biological oxygen demand (BOD), chemical oxygen demand (COD), odour nuisance, etc.).

(b) Process for Food/Fodder (Session Co-Moderator: D.G. Cunningham, Guelph)

Basically, there are two process strategies for the production of SCP/MBP (single cell proteins/microbial biomass protein) from lignocellulosics. One relies on liquid-state aerobic cultures (mainly *Candida utilis*) using hydrolysates containing both hexoses and pentoses; this is a well-established strategy with proven product acceptability. The other strategy that promises to be more economic, but is not yet established, uses a more direct solid-state fermentation (e.g., *Cellulomonas, Trichoderma,* and *Chaetomium* species).

An alternative approach to the food/fodder objective is mushroom cultivation, of which there are several options (various fruiting bodies) yielding tasty but slow-growing products. This area of activity is severely hampered by the lack of adequate feeding trial evaluations, possibly because of relatively high research

costs for evaluations such as toxicity, teratogenicity, nitrogen protein utilization (NPU), metabolizable energy (ME), with mice, rats, poultry, swine, cattle, etc.

(c) Processes for Liquid Fuels (Session Co-Moderators: G.G. Stewart, London; D.G. MacDonald, Saskatoon)

The traditional and major current approach to this option is the production of fuel-grade ethanol. Despite the global oil "crisis," this route remains uneconomical, primarily because of high pretreatment and recovery (distillation) costs and the inability to achieve adequate fermentation levels of pentoses even with the "best" cultures (e.g., with *Pachysolen tannophilus*) or enzyme combinations (e.g., immobilized glucose isomerase). Novel immobilized-cell bioreactors (e.g., *Saccharomyces cerevisiae, Zymomonas mobilis*) indicate certain technology improvements, but the overall process economics are still not good enough. So far, results on butanol/acetone and microbial fats and oils are even less promising despite active research in these areas.

(d) Processes for Gaseous Fuels (Session Co-Moderator: J.M. Scharer, Waterloo)

The production of biogas (60% v/v methane) from agricultural residues (mainly mixtures of manures and straw) for small-scale heating and illumination purposes has been successfully practiced in several developing countries (notably China, India) for many years. Larger-scale operations are more difficult to assess in terms of technoeconomic viability. A better understanding of this complex microbiological process is being sought to allow design and operation at optimal conditions. The effects of carbon/nitrogen ratios, bulk mixing, pH, temperature (mesophilic vs thermophilic ranges), process staging (acidogenic vs methanogenic phases) are actively being researched. Various bioreactor designs (free suspensions, sludge blankets, fixed-films, trickle beds, etc.) are also being compared. Other potential fuel gases, such as hydrogren, by bioconversion processes are in embryonic stages and have no meaningful place in the real world at present.

(e) General Considerations (Session Co-moderator: S.M. Martin, Ottawa)

There are many other factors besides the scientific and technoeconomic ones already mentioned that can "make or break" the application of a process. For example, geopolitical and cultural factors may become overridingly important in an unconventional food type. In addition, alternative chemical methods of producing fuel and food products must be compared to existing and proposed bioconversion ones.

In an attempt to provide some focusing, participants were also sent in advance five subdivisions of each of the session topics already discussed. Those subdivisions are identified in Table 1.

Results and Recommendations

- Overall, the conference is considered a failure in terms of generating new information. It may be considered a success for some groups (especially

those in developing countries) where the current scientific literature is not readily available. It was a limited success in introducing potential users to a "new" method of holding a scientific conference. The system was fairly easy to learn and use. However, it is possible that a simpler electronic mail system would have been adequate for most of the participants' needs; certainly it could have been much cheaper.

- It is probably wishful thinking to expect that the effectiveness of conferences of this type strongly depends on the input of the moderator and co-moderators. In this case study, participants rarely seemed to take cues

Table 1. Moderator's subjective ratings based on an increasing scale of 0–5 of the extent of new data presented and the discussion frequency of the various topics proposed.

	New data	Discussion frequency
Upstream process considerations		
Availability, types, and compositions of lignocellulosics	0	1
Physical and chemical pretreatment methods	1	3
Biological and enzymatic pretreatment methods	0	3
Production and characterization of relevant enzymes	2	5
Miscellaneous	0	2
Processes for food/fodder		
Liquid substrate fermentations	0	1
Solid substrate fermentations	0	2
Mushroom cultivations	1	3
Quality and application of products and byproducts	0	1
Miscellaneous	0	1
Processes for liquid fuels		
Systems for ethanol	1	3
Systems for butanol/acetone	0	2
Bioreactor design and operation	1	1
Quality and application of products and byproducts	0	1
Miscellaneous	0	1
Processes for gaseous fuels		
Systems for methane biogas	2	5
Systems for fatty acid intermediates	1	2
Bioreactor design and operation	2	5
Quality and application of product and byproducts	1	3
Miscellaneous	1	1
General considerations		
Process integration, implementation and economics	1	2
Materials of construction and plant maintenance	1	2
Geopolitical, cultural and related factors	2	4
Nonbiological process options	0	0
Miscellaneous	0	0

from the session moderators and often addressed issues of their own choice. In fact, there were examples of possible misuse of the medium for personal advertisements, etc., by participants. Admittedly, the session co-moderators could have played a more active role; indeed, except for the initial inputs of one or two co-moderators there were virtually no contributions from them in the later stages of the conference. In a conventional conference, there would have been less likelihood of this happening. This observation leads to the next point.

- The delegates in North America, including the co-moderators, who were "selected" to participate in the conference, are renowned researchers in this field. It is suspected that their lack of involvement is related to their usual busy schedules and, in particular, to the concern of new information being released before conventional "bona-fide" publication in journals. In this context, my own students decided not to continue in the conference after the first few weeks because "it was a waste of time" in terms of learning anything new.

- The rapporteur seemed to have had relatively little "hand-holding" to do during the conference since participants tended to solve their own technology problems. It may have been useful to have had preconference workshops for participants to give hands-on practice with the EIES system. During the conference itself many problems, which participants experienced on terminal hookups, etc., caused discouraging frustrations. The intended "hand-holding" function of the rapporteur is admirable but it became "a solution in search of a problem" in our case. However, the rapporteur was instrumental in "dumping" the relevant COM material into the EIES conference and vice versa, thereby allowing us to communicate with our Scandinavian colleagues.

- In general, the computer-based system offered a convenient asynchronous method for ongoing communications between laboratories around the world. For this computer system, lack of capability for readily presenting graphical illustrations, mathematical expressions, chemical structures, etc., placed a limitation on the conference. Backup regular mail is to be recommended. The cost of the EIES system itself is considered prohibitively high for this type of conference. In fact, one participant summarizes the general feeling: "at $75 per month, we can buy a lot of good journals which are more useful to us." Alternative systems should be checked.

- For virtually all the participants, this was their first experience with a computer-based conference. As expected, the initial period (May–June 1983) was primarily a slow learning process with relatively few participants in the system. By contrast, there was substantial "information overload" during the 1-week period (12–16 December 1983) of the concentrated "dispersed workshop" phase of the conference. (This phase also involved additional nonregular participants entering the discussion via 'nodes' having appropriate terminals in various countries.) In retrospect, a "limiter" mechanism for daily input lines would have minimized the overload problem.

- As indicated in the table, there was relatively little new technical information revealed during the conference. Regard for confidentiality and prepublication concern may have been deterrent factors. Attempts to pro-

mote a publication monograph of extended abstracts did not receive enough response. There was a tendency for repetitious debates, presumably because of the failure of these participants to check preceding discussions before entering the conference. Short of censoring inputs, it was difficult to prevent these.

Concluding Remarks

Despite the personal reservations on the outcome of the exercise, informal feedback indicated that participants were fairly happy with the experiment and have found it useful, mostly for the experience in computer-based networking rather than for any new scientific knowledge gained. In retrospect, a brief face-to-face meeting of the participants at an intermediate stage during the conference period would have been helpful in promoting improved on-line dialogue. However, until science and engineering researchers are convinced of the need/necessity to become literate in computer conferencing techniques, only the computer-prone managers of research contracts seem to be interested in using this medium, possibly because of its power to maintain records and generate progress reports fairly quickly. At present, I suspect that the average researcher would rather spend the time reading journals rather than learning about computer conferencing. In the interim, a simple electronic mail network should be encouraged.

At this stage, a follow-up conference is being considered, hopefully implementing a much less expensive and user-friendly system such as Cosy (based at Guelph) or CONTACT (based at Waterloo), on a much more focused topic, "criteria for a modular, transportable fermentation pilot plant." This is to complement a concurrent Scandinavian COM-sponsored one on "criteria for a modular, transportable lignocellulosic pretreatment pilot plant."

References

1. Barney C. 1984. Computer conferencing with EIES. PC Magazine, 270, January 1983.

2. Moo-Young, M. and Robinson, C.W. (ed.) 1981. Advances in biotechnology. Volume II: fuels, chemicals, foods and waste treatment. Pergamon Press, Oxford, England. 719 p.

Evaluation of Participants' Experiences and Attitudes

Jo Tombaugh[1]

The objectives of the evaluation of the computer conference on bioconversion of lignocellulosics for fuel, fodder, and food were established by a meeting of the Evaluation Planning Committee (composed of the members of the Canadian Organizing Committee, the evaluators and representatives of some of the funding agencies). The meeting was sponsored by the International Development Research Centre (IDRC). In the meeting, it was decided that the main purpose of the evaluation was to determine whether the participants considered the conference to be a success along two dimensions: first, with respect to the technology itself and, second, with respect to its scientific value. Not only was the evaluation to provide information relevant to a decision on whether or not to hold a computer conference, it was also to make recommendations for improvement of computer conferences in the future.

Finally, the planning committee insisted that the questionnaires should be short and easy to fill out so that a high rate of return from the scientists who participated could be achieved. Thus, the questionnaire would not be used to collect large amounts of background material on the individuals or on their utilization of various commands in the conferencing system they used but only to examine whether they accepted the system, its perceived scientific value, and areas where change is required.

To this end, the questionnaires were developed by adapting some of the questions used by the Electronic Information Exchange System (EIES) group to measure acceptance of their system. In addition, questions submitted by various members of the committee and their voiced concerns about the factors affecting the success of the conference were used to develop other items. Two questionnaires, each limited to the front and back of a single page were developed for the participants. The form of the participation questionnaire was somewhat different for the on-line and off-line participants, although many of the questions were identical. Finally, a one-page questionnaire was sent to a number of nonparticipants to determine what factors contributed to their decision not to join. Copies of the questionnaires are found in the Appendix.

Because of the decision to limit the focus of the questionnaire, it does not cover many of the variables described by Kerr and Hiltz (1982)[2] in their comprehensive systems approach to evaluation of computer conferences. They consider system design, acceptance and usage of the system, and impacts of system use on individuals and groups. In terms of such a framework, the current evaluation is

[1] Department of Psychology, Carleton University, Ottawa, Ontario, Canada K1S 5B6. (Research reported here was funded by the United Nations University.)

[2] Kerr, E.B. and Hiltz, S.R. 1982. Computer-mediated communication systems. Academic Press, New York.

limited to consideration of some aspects of user acceptance of the system, as well as some of the perceived behavioural impacts of system use on individuals and groups.

Questionnaire Returns

Participants

Questionnaires were mailed to all individuals on a master participation list furnished by IDRC. A second mailing was made to those who had not responded at the end of 1 month. Because the IDRC list also contained potential, rather than known participants, the covering letter in the second mailing instructed individuals who had not participated in the conference to return a special form instead of the questionnaire.

Table 1 shows the return received for the three main subgroups on the mailing list: (a) participants on the EIES system, (b) participants on COM, and (c) participants who communicated by telex and mail (off-line). As shown in the table, COM appeared to have a much higher percentage return than EIES. However, this difference is probably due to a variations in how the lists were formed. The COM mailing list involved one person per account. On the other hand, some of the accounts in the EIES list were associated with a large number of names; there were 33 accounts and 107 names for an average of more than three names per account. Most of the nonrespondents came from accounts that had submitted long lists of participants. In fact, three accounts in the United States submitted a combined total of 31 names and accounted for 21 of the 29 EIES nonrespondents. In addition, if the number of EIES accounts is considered, 31 of the 33 accounts were heard from, for a total of 94%, a return comparable with that for COM.

Nonparticipants

A one-page questionnaire was sent to 178 individuals who had not participated in the conference. This list included three categories of nonparticipants: all 55 of those invited from developing countries, 33 individuals who had accounts opened

Table 1. Returns of participation questionnaires.

	EIES	COM	Off-line	Total
Total letters sent	107	23	23	153
Responding nonparticipants	18	1	0	19
Completed questionnaires	60	20	17	97
No answer received	29	2	6	37
Percentage completed[a]	67	91	74	72

[a] Percentage = 100 (completed/(completed + no answer)).

Table 2. Number of questionnaires by place and account type.

	Account type		
Place	EIES	COM	Both
Industrialized, North American	47	0	2
Industrialized, other	7	18	3
Developing	3	1	0

for them but had not participated at all, and 95 taken at random from other lists of those invited in the industrialized countries. A 70% return from developing countries and a 52% return from the industrialized countries was received after one mailing so that a second mailing was deemed unwarranted.

Characteristics of Participants

Type of Country and Account

As mentioned earlier, of the 97 respondents, 60 were from EIES, 20 were from COM, and 17 participated off-line. However, of equal concern for the purpose of the conference is a distribution based upon the industrialized state of the participant's country. Of the 97 questionnaires that were returned, 54 were from Canada and the United States, 29 were from industrialized countries outside of North America, and 14 were from developing countries. Most of the participants from industrialized countries participated on-line, whereas 10 of the 14 developing-country participants were off-line. Because of this high correspondence, it is not possible to determine statistically whether differences in responses between developing and industrialized countries are a function of the type of participation or location. That is, mean ratings are nearly identical for the off-line and developing-country responses because they contain a high proportion of the same individuals. Although analyses will be reported in terms of developing-country statistics, it is important to keep in mind that they also represent off-line users quite accurately.

For the on-line users, the type of account held is highly dependent on the location of the participant. As shown in Table 2, North American participants all have EIES accounts, whereas the majority of users in the other industrialized countries have COM accounts. Because few differences are found between the industrialized North American and other industrialized countries, results are often presented as a simple comparison between industrialized and developing countries.

North American Participants

Other classifications of the respondents are possible. Of the 54 North American participants, 35 were from Canada and 19 were from the United States. A comparison of these two subgroups showed no differences in how they responded to the questionnaires; no further information will be given on them in this report.

Employer

Forty questionnaires were returned from universities, 40 were returned from government employees, and 12 were from private industry (five could not be classified). Again, there were no differences among these groups to report.

Type of Participants

Finally, of the 81 on-line participants, six were co-moderators and five were involved from an organizational perspective rather than as scientists in the subject area of the conference. The conference moderator did not submit a return due to his concern for potential skewing of the results (his perspective is documented in a separate chapter). These subgroups are not large enough to compare statistically; however, the rating scale results are similar whether or not they are included in the

sample. Thus, unless otherwise stated in reporting the results, the sample does include these individuals.

Topics of Interest

Participants were asked to indicate which of the conference topics were of interest to them and to circle their major interest. The majority of the participants indicated an interest in more than one topic, with two interests being the most common (e.g., one topic, 25%; two, 34%; three, 20%; and more than three, 21%).

Table 3 indicates that number of respondents reporting a major interest in each of the topic areas for the industrialized and developing countries separately. Liquid fuels was the topic most often considered of interest to the participants from the industrialized countries, whereas food/fodder was of greatest interest for the developing countries.

System Use

Account Statistics

Both EIES and COM furnished us with statistics on the amount of time each account in the conference was connected to the system on a monthly basis. In addition, it was possible to determine how many of the conference items had been read by each account at the end of the conference. A number of other statistics were made available to us from COM, e.g., the number of comments made, number of private messages sent, number of items read. However, because EIES did not furnish comparable data, this information is not reported.

The reported connect time for an account is the total for all users of that account. In addition, the connect time represents all use of the account. Thus, if participants are following more than one conference, this activity is reflected in the times.

Table 4 shows the total number of accounts and the number of active accounts on a monthly basis. (Active accounts appear in the accounting statistics that show a connect time greater than zero hours. Total accounts include those that are established, but not in use, as well as the active accounts.) There is a general growth, particularly in the number of active accounts, which nearly doubled in the 6 months of the conference.

Table 3. Number of participants expressing an interest in each topic.

	Industrialized		Developing	
Category	Number	Percentage	Number	Percentage
Upstream process	39	21	5	12
Food/fodder	31	17	12	30
Liquid fuels	50	27	8	20
Gaseous fuels	18	10	8	20
General	30	16	4	10
Other	17	9	3	8
Total	185	100	40	100

Table 4. Total number of accounts and those which are active by months.

Month	EIES		COM		Total	
	Total	Active	Total	Active	Total	Active
June	20	11	37	22	57	33
July	17	13	40	27	57	40
August	18	14	40	27	58	41
September	26	20	41	29	67	49
October	27	19	41	28	68	47
November	32	25	44	26	76	51
December	36	31	44	30	80	61

Table 5. Statistics indicating intensity of use by month.

Month	Median time (minutes)	Comments	Pages
June	74	52	19
July	114	49	20
August	119	43	28
September	64	31	18
October	96	53	31
November	125	35	25
December	331	295	185

Table 5 gives an indication of the intensity of the activity in the used accounts. Median, rather than mean, use was taken as an indicator of typical behaviour because the mean was highly influenced by a small number of users who were involved in several conferences. Half of the participants used the system less, whereas the other half used it more than the median time. The conference proceedings were used to determine amount of activity in terms of the number of comments and number of pages of written text per month. These figures are approximate in that a few COM comments were made toward the end of one month but appeared in the EIES proceedings in the following month.

All of the indicators above point to very heavy activity in December. This activity can be attributed primarily to dispersed workshops involving both face-to-face and computer communication. Groups held discussions at different locations on planned topics and entered summaries of their discussions into the conference. Because of this activity, most of the conference comments in December were connected with the dispersed workshop, either its planning or its input. Because users were asked to fill out the questionnaire at the end of December, the ratings of those participants involved in this phase would be influenced by this activity.

Total connect time per account and notices read were also considered. Accounts of those in the nonscientist category were not included in these statistics to avoid inflating the participation time. Some of these persons were involved in several different conferences and logged much more time than typical users. Overall, the mean connect time per regular account was 18.9 hours. In addition the mean number of comments read per account was 410.

Self-Reported Use

As mentioned, it is not possible to assess accurately the amount of conference participation by the individual from the account statistics because the accounts

are often shared and used for activities other than participation in the conference. Consequently, users were asked to estimate their participation on the questionnaire. Table 6 shows the questions and the percentage responding in each category.

Comparison of Account and Self-Report Statistics

The correspondence of these reported statistics and the account statistics on connect time and number of items read was examined. It was necessary to use the self-report data of only one person per account in computing these comparisons to avoid multiple use of the same account information. Thus, only the first name from lists of multiple participants from an account was used in compiling these tables, because this person was usually in a position of primary responsibility. In addition, performance of the conference participants who were not interested in the scientific content were eliminated in determining these means. Although perfect correspondence between reported use and the account statistics would not be expected, there should be some correspondence if the self-report scales are to be considered valid. As shown in Table 7, there is correspondence between user estimates of amount contributed and the corresponding account information on connect time and comments read.

This was not the case for the percentage of proceedings read however. As shown in Table 8, the relationship between reported amount read and the account information is not direct. Participants reporting 25–74% read were associated with accounts that spent less time on-line then those reading less than 25%. It is possible that participants inaccurately estimated the percentage read. In particular, those who knew nothing of the December activity would believe they read a

Table 6. Response to questions on participation.

Questions	Response categories	Percentage
Approximately what percentage of the conference proceedings did you read?	< 25%	12
	25–49%	10
	50–74%	21
	⩾75%	57
Your level of participation as a contributor to the conference was	Regular	22
	Occasional	52
	None	26

Table 7. Relationship of self-report on amount contributed and actual account activity.

Amount contributed	Mean account time (hours)	Mean notices read
Regular	27.6	532
Occasional	13.7	386
Never	9.2	256

Table 8. Relationship of self-report on amount read and actual account activity.

Amount read (%)	Mean account time (hours)	Mean notices read
< 25	13.3	225
25–49	7.7	306
50–74	6.5	338
⩾ 75	20.0	474

higher percentage than those who, having followed the conference longer, were aware of the large amount of activity in December. However, it is more likely that the reported amount read is accurate but that connect time does not give a good indication of this statistic. The reason for reaching this conclusion is that the reported amount read does correspond well with the account statistics on number of comments read. Thus, connect time is a better indicator of amount contributed than amount read, whereas contributions read are related to reported amount read and also to the number of contributions made.

There was a relationship between amount of use and amount read, both in the account statistics and in the user reports. Of the number of regular, occasional, and noncontributors who reported reading less than 75% or more than 75% of the proceedings, the majority of regular contributors read more than 75% whereas the majority of those who did not contribute read less.

Assistance in System Use

A question was used to establish whether or not the respondents were direct users of the system. Of the percentage of those who answered this item in each category, the majority used the system directly, but more than one-third always had someone else use the system.

A major interest is the correspondence of the assistance factor with other usage statistics. The percentage of respondents falling into each cell of a joint table for assistance and contribution is shown in Table 9. This table shows that most of the participants who always have assistance are occasional contributors, whereas those that sometimes or never have assistance are equally split as regular and occasional participants.

As shown in Table 10, a similar relationship is found for amount read and amount of assistance. About half of those who always had assistance reported reading 75% or more of the proceedings, whereas 70–80% of the individuals who had less assistance read 75% or more.

Although this correlation of amount of assistance and participation is interesting, it should be noted that the causal link between the two is probably not direct.

Table 9. Joint distribution of amount of assistance and amount contributed expressed as a percentage.

	Contribution		
Assistance	Regular	Occasional	None
Always	4	24	6
Sometimes	10	10	2
Never	18	20	6

Table 10. Joint distribution of amount of assistance and amount read expressed as a percentage.

	Amount read	
Assistance	$< 75\%$	$\geq 75\%$
Always	16	18
Sometimes	4	18
Never	12	32

Taking away the assistance is very unlikely to result in greater use. To the contrary, the participant who never uses the computer personally is probably less committed in general to the concept of computer conferencing, so that without someone else to use the machine, this person might not have participated at all. Dislike of using the computer was reported to be a greater factor in limiting the participation of this group than it was for those who never had assistance.

Willingness to Participate in Future Conferences

A major question of interest in judging participant reaction to the conference was the following question: "If you were invited to participate in another computer conference on a topic of interest to you in the near future, do you feel you would participate?" This question was answered as "yes," "uncertain," or "no" by 78%, 16%, and 6%, respectively. All of the developing-country participants were willing to participate in the future, whereas 75% of the industrialized-country participants gave a positive response.

Thus, in general, most of the participants are interested in participating in future computer conferences. Because of the small number of respondents indicating that they would not participate, those who are uncertain or not interested are grouped together for further analysis.

Analysis of Item Ratings

Two sections of the questionnaire for conference participants dealt with negative statements. In the participation questionnaire, problems that distracted from use of the conference were rated, but in the scientific value questionnaire, possible drawbacks to using the conference were described and the respondent was asked to rate the extent to which he or she agreed or disagreed with the statement. In both cases, a score of 5 indicated that the rater considers the problem or drawback described in the item as a major concern, but a score of 1 indicates it is not a difficulty.

A positive set of items is also found on each questionnaire. In the participation questionnaire, participants were asked to rate factors encouraging use of the system, and on the scientific value questionnaire, they rated benefits of participating in the computer conference. On these scales, a score of 5 represents strong agreement with the positive view of the statement, whereas a 1 indicates strong disagreement.

A major concern in presenting mean ratings for a large number of respondents on a questionnaire is the degree to which the mean ratings apply to different subgroups contained in the study. To address this problem, a measure of agreement among subgroups called the Pearson correlation coefficient was applied to the mean ranks for subgroups. A correlation coefficient equal to 1 would indicate perfect agreement in the ratings of the subgroups, whereas a correlation equal to 0 would represent a total independence of the responses. A large number of subgroups were compared: North American and European; Canadian and American; government, university, and private industry; EIES accounts and COM accounts; and industrialized- and developing-country participants. The measure of agreement or correlation coefficient was computed separately for the rankings of the positive and negative items.

For the ratings, all but one of the comparisons among groups were above 0.75, indicating good correspondence in the ratings. The exception was found for the developing and industrialized countries when the negative ratings were considered. The correlation was only 0.06, showing a total lack of correspondence. Thus, the negative ratings are reported separately for industrialized- and developing-country participants, whereas the positive ratings are reported jointly.

Ratings of All Negative Comments

Industrialized Countries

Table 11 shows the mean rating for each negative statement for the industrialized-country participants. The items are ordered from those having the highest to lowest mean ratings. In addition, the percentage of respondents giving a 1 or 2 rating to each item is presented. This statistic indicates the percentage of respondents who considered each statement to be a very minor problem. Thus, the first item, "there was repetition in the comments," is the one that respondents were most negative about. The mean rating was 3.3, and the percentage who saw this as a minor problem was only 22%. There is general correspondence between the means and the percentage scores; few items would change their

Table 11. Ordered mean ratings and percentage of respondents for whom the item was rated 1 or 2 for participants from industrialized countries (the higher the mean the greater the problem).

Mean	Percentage 1 or 2	Item
3.3	22	There was repetition in the comments.
3.1	26	Other activities have higher priority.
3.0	36	Most participants unwilling to share ideas.
3.0	39	Lack of response to contributions.
2.8	35	I was concerned about accuracy of information.
2.8	41	Difficult to find comments of interest to me.
2.7	45	Too much information.
2.6	49	I was reluctant to contribute to open conference.
2.6	52	Lack of graphics and/or mathematical symbols.
2.5	53	Few benefits not worth the time and effort.
2.4	47	Items I have received are not worth reading.
2.4	57	Lack of facility for off-line editing.
2.4	58	Developing-country scientists gained nothing.
2.4	59	Industrialized-country scientists gained nothing.
2.2	68	Lack of face-to-face contact.
2.1	72	Using a conference to communicate is complicated.
2.0	66	Level of knowledge of participants not high enough.
2.0	70	Not interested in the topics being discussed.
2.0	70	Lack of experience with computers.
2.0	75	Instructions difficult to understand.
1.9	72	Costs of participation.
1.9	72	No one in conference I wanted to communicate with.
1.8	75	Lack of technical assistance to learn the system.
1.8	81	Difficulty with the telecommunication link.
1.7	81	The need to be able to type to enter comments.
1.6	80	Difficulties with access to a terminal.
1.6	83	Administrative difficulties.
1.5	84	Dislike of using a computer to communicate.
1.5	88	Possibility of reduced international travel.
1.3	92	Difficulty in obtaining approval to participate.
1.1	99	The need to be able to read or write in English.

position in the ranking by using percentages instead of means. The discrepancies that exist are due to differences in how responses to the item are distributed. Whether the relative positions of two items in the table should be taken seriously can best be judged by the difference in their mean ratings. In general, if there were only random fluctuation in responding between two items, a difference of 0.3 or more would have less than a 1% chance of occurring. Consequently, a difference of 0.3 is considered statistically significant. Smaller mean differences, such as between items with mean ratings of 2.3 or 2.2, are not statistically significant.

Along with time (other activities took a higher priority), the major problem for the industrialized-country participants was content related: repetition in the comments, lack of response to contributions, participants unwilling to share ideas, difficult to find comments of interest to me, concern about accuracy of information, and too much information. Lack of graphics and off-line editing facilities were the major technical concerns for the on-line users.

On the whole, respondents answered the items as written. However, nine individuals modified the item "too much information" on their questionnaires to make it read "too much irrelevant information" or "too much information of low quality." Consequently, it is likely that a large number of respondents are interpreting the item in this sense.

It should be noted that the terms "on-line participants" and "industrialized-country participants" could be used interchangeably. Table 11 applies equally well to both divisions of the data. The few individuals who are affected by the difference in classification do not affect the means in a substantial way.

Developing Countries

The rating of negative items is dramatically changed for the developing countries, as shown in Table 12. It should be noted, however, that these mean ratings have less statistical stability than those for the industrialized countries because they are based on a much smaller sample size. On the average, the ratings must differ by 0.6 to be considered statistically significant at the 1% level. This lack of stability is reflected in the less-ordered relationship between the means and percentage of 1 and 2 ratings. It is clear that the major difficulties for the developing countries are the telecommunication link, followed by problems with access to a terminal.

Comparison of Industrialized- and Developing-Country Ratings

Tests of significance on the mean ratings for the industrialized- and developing-country participants were conducted using the 1% level of significance. Difficulties with the telecommunication link, access to a terminal, and problems with cost of participation were greater for the developing countries, but the items concerned with too much information, items not worth reading, difficult to find comments of interest to me, nothing of worth for industrialized- or developing-country scientists, and the complexity of communicating through a conference were significantly greater problems for the on-line participants. Thus, there is a shift from concern with technical difficulties to information-related problems between the two groups.

Nonparticipants

Finally, a subset of the items available to participants is found on the nonparticipants' questionnaire. Items concerning information were not found on this questionnaire because these respondents did not read the proceedings. Sample

Table 12. Ordered mean ratings and percentage of respondents for whom the item was rated 1 or 2 for developing-country participants (the higher the mean the greater the problem).

Mean	Percentage 1 or 2	Item
4.2	23	Difficulty with telecommunication link.
3.3	46	Difficulties with access to terminal.
2.7	45	Other activities have higher priority.
2.7	51	Costs of participation.
2.3	46	Lack of graphics and mathematical symbols.
2.3	60	There was repetition in the comments.
2.3	72	Lack of response to contributions.
2.1	62	Lack of face-to-face contact.
2.1	67	Most participants unwilling to share ideas.
1.9	67	Lack of technical assistance to learn the system.
1.9	71	Possibility of reduced international travel.
1.9	64	Difficult to find comments of interest to me.
1.8	90	I was concerned about accuracy of information.
1.7	85	Lack of experience with computers.
1.7	92	Few benefits not worth the time and effort.
1.6	78	I was reluctant to contribute to open conference.
1.5	93	Administrative difficulties.
1.5	92	Using a conference to communicate is complicated.
1.4	82	No one in conference I wanted to communicate with.
1.4	83	Developing-country scientists gained nothing.
1.4	93	Too much information.
1.4	99	Items I have received are not worth reading.
1.2	91	Not interested in the topics being discussed.
1.2	99	Level of knowledge of participants not high enough.
1.2	99	Industrialized-country scientists gained nothing.
1.1	93	Difficulty obtaining approval to participate.
1.1	99	The need to be able to read and write in English.

sizes for both the industrialized countries (67) and the developing countries (35) were large enough to result in statistically significant differences at the 1% level for ratings that differed by 0.3 and 0.4 for the two groups respectively. Results for the items used for the industrialized countries are shown in Table 13. As can be seen, time (other activities took higher priority) dominated the reasons for not participating.

This is not the pattern in the developing countries, as shown in Table 14. Although the correlation of industrialized- and developing-country ratings is higher for the nonparticipants (0.32), the correspondence is modest. For developing-country respondents, cost, difficulties with the telecommunication link, and difficulties with access to a terminal were the major concerns.

Differences in the ratings between the industrialized- and the developing-country groups that were statistically significant at the 1% level were determined. Greater priority for other activities was more of a problem for the industrialized countries, whereas cost of participation, difficulties with the telecommunication link, and access to a terminal and administrative difficulties were higher for the developing countries. This pattern seems to correspond well with the results found for the participant questionnaires in that the developing-country scientists are facing more technical difficulties while the industrialized countries are making decisions on the basis of time constraints.

Ratings on Positive Items

Two sections of the questionnaire dealt with positive statements concerning the benefits of the conference. Respondents were asked to rate each item from 1 to 5 with a 1 indicating strong disagreement and 5 indicating strong agreement. On the positive items, unlike the negative items, there was strong agreement in the rankings for the industrialized- and developing-country participants. There were no statistically significant differences in the ratings. Consequently, Table 15

Table 13. Ordered mean ratings and percentage of respondents for whom the item was rated 1 or 2 for nonparticipants in industrialized countries (the higher the mean the greater the problem).

Mean	Percentage 1 or 2	Item
3.8	24	Other activities take higher priority.
2.3	53	Lack of face-to-face contact.
2.3	57	Costs of participation.
2.3	60	Difficulties with access to a terminal.
2.2	61	Lack of interest in the proposed topics.
2.1	64	Using a computer to communicate is complicated.
2.1	64	Lack of experience with computers.
2.1	65	Difficulties with the telecommunication link.
2.0	67	Dislike of using a computer to communicate.
2.0	69	Lack of technical assistance in learning the system.
1.9	72	No one with whom I wanted to communicate.
1.8	72	The need to be able to type to enter my comments.
1.7	80	Reluctant to contribute to open conference.
1.6	83	Administrative difficulties.
1.6	80	Possibility of reduced travel opportunities.
1.5	85	Difficulty obtaining approval.
1.5	87	Did not know about the conference.
1.0	100	The need to read and write in English.

Table 14. Ordered mean ratings and percentage of respondents for whom the item was rated 1 or 2 for nonparticipants in developing countries (the higher the mean the greater the problem).

Mean	Percentage 1 or 2	Item
3.9	17	Costs of participation.
3.5	31	Difficulty with the telecommunication link.
3.4	31	Difficulties with access to a terminal.
2.6	51	Other activities took higher priority.
2.5	51	Lack of experience with computers.
2.4	54	Using a computer to communicate is complicated.
2.4	57	Administrative difficulties.
2.3	60	Possibility of reduced travel opportunities.
2.3	65	Lack of technical assistance in learning the system.
2.1	63	Difficulty in obtaining approval to participate.
1.9	71	Did not know about the conference.
1.8	71	The need to be able to type to enter my comments.
1.8	74	Lack of face-to-face contact.
1.7	74	Dislike of using a computer to communicate.
1.7	80	Lack of interest in the topics.
1.4	85	There was no one with whom I wanted to communicate.
1.4	86	I was reluctant to contribute to open conference.
1.3	89	The need to read and write in English.

shows the ratings ordered from most to least positive for the on-line participants. Along with the mean ratings, the percentage who responded with a 1 or 2 is also given. These are the percentage who definitely disagree with the item. Thus, the most important benefit to the scientists is the written record. The mean rating is 4.1 and only 8% disagreed.

Although there were no statistically significant differences in the ratings of the developing- and industrialized-country respondents using the 1% level of significance, two items "I got ideas for future research" and "the conference content was useful to my work" were marginally significant. Thus, there is a tendency for developing-country participants to benefit more from the scientific content.

It is clear that the advantages most appreciated were items concerned with computer conferencing as a technological advance rather than the actual knowledge gained from the conference. Although 14 of the items had mean ratings of 3.0 or greater (3 represents neutral to the item), only three of these deal with direct advantages: increased general knowledge, learned of reports or references, and made useful new contacts. On the other hand, four of the six comments below 3.0 were content related: content useful to my work, got ideas for research, changed my view of how my work relates to others, and learned of techniques of practical application to my country. Thus, participants seem to be responding more to the potential of computer conferencing than to the substance of this

Table 15. Ordered mean ratings and percentage of respondents for whom the item was rated 1 or 2 for positive items (the higher the mean the more agreement with the statement).

Mean	Percentage 1 or 2	Item
4.1	8	Written record of conference available.
3.8	12	Could participate when convenient.
3.7	12	Learned new way of communicating.
3.7	16	Could think over response before answering.
3.6	22	Faster than using the mail.
3.6	22	Could communicate worldwide at uniform cost.
3.5	18	Increased general knowledge.
3.5	21	Less expensive than travel.
3.4	22	Participation did not interfere with other activities
3.2	24	Learned of reports or references.
3.2	26	Could express myself less formally than publication.
3.2	26	More easily reached people.
3.1	28	Made useful new contacts.
3.0	33	Less chance of misunderstandings.
2.9	36	I enjoyed using the computer.
2.8	36	Content was useful to my work.
2.8	42	Got ideas for research.
2.6	47	No one could interrupt my comments.
2.4	46	Changed my view of how my work relates to others.
2.4	55	Learned of techniques of practical application in my country.
		Questions answered only by those who entered comments (N = 75)
3.1	29	My contribution useful to developing countries.
2.8	39	My contribution recognized as significant.
2.7	51	I received a satisfactory response to questions.

conference. As will be seen later, comments made by the users tend to support this interpretation.

Comparison of Negative and Positive Scales

Both the positive and negative items show a tendency to result in "better than neutral" ratings. Sixty-one percent of the positive items were above the neutral point of three, indicating generally positive responding. In addition, 94% of the negative items were below the neutral point. Because low scores on the negative scale mean "not at all a problem," this is also a positive tendency. However, respondents to questionnaire items tend to have a bias to respond in a positive manner — which will please those asking the questions. Thus, the

Table 16. Number of comments to open-ended questions.

	Number who responded	Number of responses
Scientific value questions		
Other benefits to you	21(21.6%)	25
Other drawbacks for you	23(23.7%)	35
Changes which would have increased value	47(48.5%)	103
Participation questions		
Other factors limiting use	33(34.0%)	56
Other factors encouraging use	22(22.7%)	35
Describe serious technical difficulties	20(20.6%)	29
Why would you participate (or not participate) in future conferences?	92(94.8%)	127

Table 17. Types of comments and their frequencies in "Other" categories.

Scientific value — other benefits	
Learned about computer conferencing	11
Gains in scientific information	5
New contacts with research groups	4
Learned that developing countries hard to involve	3
Other factors encouraging participation	
Negative responses to positive items[a]	10
Contacts with others	5
Scientific value — other drawbacks	
Poor content	10
Junk mail distracts	7
Inactive participants	6
Technical problems	4
Other factors discouraging participation	
Content of low quality	11
Time constraints	6
Cost of participation	5
Poor organization	3
Access to terminal	3

[a] A number of the comments by the respondents were negative in this section: e.g., It is NOT faster than the mail.

absolute values of the responses must be interpreted with caution and the comparison of the values of items on the negative and positive scales is not appropriate.

Analysis of Respondents' Comments

Table 16 shows the number of respondents who gave one or more comments to each of the write-in sections of the questionnaire. As the respondents filled out each section of the questionnaire they were invited to write in items not covered by the section. Up to 34% of the respondents contributed comments to these sections. In addition, 20% made comments about serious technical problems. Almost half of the respondents suggested changes to the conference, and 97% provided comments on why they would or would not participate in future conferences.

Frequently mentioned items are those that have particular importance to the respondents. Consequently, the major themes found in these comments are summarized and those that appeared with greater frequency are presented in the tables that follow. No effort is made to discuss more unique comments.

The comments covered in Table 17 are those in which the respondent was invited to write in items not covered by the questionnaire. In the positive comments, learning about computer conferencing and making contacts were the most frequent contributions. Quite a few negative responses were given in response to the positive participation items. These were comments such as "it is not faster than the mail," "participation did interfere with other activities," "opportunities to participate with other developing countries were nonexistent." Three respondents indicated that they learned that the developing countries were not easily involved in the conference. They saw this as a learning experience that gave them a greater appreciation of the ground work required to involve developing countries in future conferences.

The most frequent items in the negative sections of the questionnaire concerned content. Considering the two questionnaires together, poor content was mentioned 21 times and, more specifically, junk mail was mentioned seven times. There was a great deal of concern for the quality of the material. Poor participation by others, time constraints, and costs were also frequently mentioned as drawbacks to the conference.

Some of the respondents made comments about, or qualified, particular items on the questionnaire. For example, in the section on "factors discouraging participation," two items to be rated were "cost of participation" and "too much information." With regard to the first item, a number of respondents made comments such as the following: "cost was not a problem because I was funded by . . . . But it would be otherwise." The item "too much information" was frequently modified or qualified to indicate that there was too much low-quality information. One participant noted there was too much information in December only.

A major value of the comments in these sections of the questionnaire is that they provide feedback that can be used to improve the questionnaire in future evaluations. For example, different wording of some items was indicated. Although questionnaire did contain items concerned with low-quality contributions, it was clear from the comments that more bluntly worded items would have been appreciated. Terms such as "junk mail" and "garbage" were often used. In

Table 18. Classification of comments about future participation.

Comments of those who answered "yes" to future participation	
See potential	9
Need to stay informed	8
Direct exchange of ideas	8
General enthusiasm	6
Interested in the technology	5
Convenience	4
Speed	4
Like informality	3
Worldwide network	3
In touch with experts	3
Fills unique communication need	3
Comments of those who answered "maybe"	
If better content	5
Depends on cost	2
Comments of those who answered "no"	
Lack of value	4

addition, there were some problems that were not covered in the items. For example, content; there were four individuals who requested more background material to follow the discussions. "Comments were too specialized with no introduction, made it difficult for the reader with only a general knowledge (e.g., most of those in developing countries)." Problems with lack of organization and focus could also be added to a future questionnaire.

Most of the reports of technical difficulties carne from outside of North America. Of the seven who complained about the telecommunication link, three reported difficulties in establishing the link and four complained of poor reliability. Two of the four complaints about the manual specifically mentioned that its information on establishing the telecommunication link was incorrect. The administrative difficulties (four total) included difficulties with passwords (two), problems with billing, and cost. Four expressed a desire for off-line editing capability.

Reasons for future participation fell into the categories shown in Table 18. They are presented separately for those who answered "yes," "maybe," or "no" to their interest in future participation. Looking first at the positive participants, it is interesting that the most common response concerns the potential of computer conferencing. "It has a great potential only partly manifest in this experiment." "Because the next one will be better than the first! Good idea, but needs refining." These people will expect changes in the next computer conference they join.

Another group of comments expresses a need to stay informed. "To keep abreast of new developments." "I want to ensure that I get all the information for my research that is available." This group will only continue to participate if they receive information that has scientific value.

Comments about the direct exchange of ideas, as well as comments about being in touch with experts, came primarily from the off-line, developing-country participants. These people were also interested in being on-line in future conferences.

Comments classified as "general enthusiasm" were of reasonably high frequency. "I enjoyed it, it was fun." "Because it is very interesting and worth the

effort and expense. I can operate the system now. It's good fun." "It is both useful and stimulating." These individuals seem directly to enjoy the technology and the communication links.

Of the other categories, some respondents are following computer conferences because of an interest in the technology and will continue to monitor future conferences. Some found it convenient, some expressed a liking for the informality of communication, and some mentioned the value of a worldwide network. Finally, the idea that it fills a unique communication need was expressed. "It is a continuous process which fills in between the journals and live conferences." "It helps you achieve a broader perspective that cannot be achieved through personal communication or face-to-face conferences."

The most common complaint of those who said "maybe" or "no" to future participation had to do with its lack of scientific value. In fact, no one complained about unreliable equipment or other technical issues (except price) in response to this question.

Given that many participants are willing to give another conference a try, but seem to expect some improvements, the suggestions about how to make the conference better are of considerable interest and the responses to this question are often quite lengthy. They take up twice as much space on the computer file as the responses to the "future use" question. The major categories of responses included: better direction or focus (22), better involvement of other participants (15), greater leadership participation (14), different emphasis in the topics (6), better use of keywords (5), and graphs (3).

The direction and focus theme given first actually has three subtopics; confine the conference to narrower topics (8), do more planning before the conference (8), and increase the intensity of the conference (6). This last category contained one suggestion for a very short conference introduced through a series of prepared papers and other suggestions for the best use of activity of the type found in the December workshop — have it earlier or in the middle, rather than at the end.

Of the comments about more participation, three suggested more assistance to the participants, three suggested that more experts should be involved, and three asked for more developing-country participation. Four suggested the use of publications or other recognition to encourage greater participation.

In an indirect way, many of the suggestions in this section require a greater contribution from the conference leadership. However, the "greater leadership participation" classification involves items where one or more leaders is directly mentioned. This includes terms such as chairman, moderator, convenor. Five of the comments in this section are general statements that there should have been more involvement. "Some of the chairmen were very active in giving encouragement to participate, others remained silent, which tended to be negative." Five comments asked for greater direction of discussion: periodic summarizing and setting new directions, development of specific scientific questions to stimulate good input, provision for position papers.

Finally, three comments directly called for the leadership to take an active role in organizing and editing the information provided. Indexing and grouping and elimination of redundancy were mentioned. The fact that keywords were

used too infrequently and inconsistently to be of value to someone attempting to use the search facility was also mentioned in four comments. Four of the six comments asking for a different emphasis in the topics were concerned that not enough content was relevant to "rural development in poor countries."

Discussion

Success of the Conference

More than 100 scientists participated in this computer conference. Seventy-five percent of those who responded to the questionnaires indicated that they would participate in a future conference on a topic of interest to them. This figure is probably inflated as a predictor of future participation. However, it is a reasonably accurate measure of the acceptance of the technology in principle. Thus, the conference can be considered a success in the sense that it introduced computer conferencing to a large number of scientists who accept it as a method of communication.

This outcome must be qualified in two ways however. First, although the conference was international, very few from the developing countries (four) were able to participate on-line. Second, in the industrialized countries, concern about the conference content was high.

Developing-Country Needs

The results of the computer conference highlight the current inability of developing-country participants to link into computerized communication systems. The concerns that must be met before more scientists are able to participate in computer communication need to be assessed. Table 19 summarizes the mean ratings for the four greatest problems for the developing-country participants (on-line and off-line) as well as the three problems most responsible for the decision not to participate by those who were not involved. As shown in the table, the major problems for both of these groups were difficulties with the telecommunication link, access to a terminal, and cost. It should be noted that cost was the overriding concern for those who were nonparticipants, whereas difficulty with the telecommunication link was primary for those who did participate. Consequently, direct funds to scientists and improved technology will be required to increase the amount of participation of the developing-country scientists.

Industrialized-Country Needs

The other clear message that came from the questionnaires is that the participants saw the potential of the technology, but were less impressed by the scientific

Table 19. Summary of the four most important problems for developing-country participants and nonparticipants.

Item	Mean	
	Participants	Nonparticipants
Difficulty with telecommunication link	4.2	3.5
Difficulty with access to terminal	3.3	3.4
Costs of participation	2.7	3.9
Other activities have higher priority	2.7	2.6

value of the content of this conference. Many who are willing to try again expect improvements. Respondents were particularly upset by low participation, low-quality comment, and a perceived lack of organization and focus. These concerns were much greater in the industrialized countries where journals and technical reports are easily obtained.

Results of Other Evaluations

Before turning to recommendations for changes in future conferences, the degree to which these problems have been reported in other evaluations of computer conferences will be considered. This information is all drawn from an excellent review of the computer conferencing literature by Kerr and Hiltz (op.cit.).

First, irregular participation appears to be a persistent problem. Of 10 evaluations that considered this problem, nine found this to be the case, and one was inconclusive. Factors that affect the willingness of a participant to communicate regularly do not seem to be under the control of the conference leadership. "Explicit expectations and deadlines can to some extent offset this, but at a cost" (Kerr and Hiltz, p. 144, op. cit). The cost, for example, might include a high dropout rate of those unable to meet the deadlines.

It is well documented that factors such as previous experience with computers, attitudes about computers, having one's own terminal as opposed to a shared one are all factors affecting amount of use. Perceived task importance is also related to use.

The idea of a critical mass is often brought forth as necessary for a successful conference. The implication seems to be that a large number of bodies must be recruited to ensure that there are sufficient comments available to make signing onto the system worthwhile. However, if critical mass was thought of in terms of improving the density of useful material available to the participant when he or she signed on, thus looking for methods to improve the quality instead of the quantity of the information, more progress would be made in finding effective methods of increasing participation. The fear of missing something is probably the greatest motivator but can only be maintained if there is something worthwhile contributed.

The problem with lack of response to questions has also been studied extensively. Although five studies reported that unanswered questions were a problem, three found that they were not a problem and one study was inconclusive. The disparity in the results is probably due to the organizational decisions about the conferences involved. A decision of the conference leadership to see that no question is left unanswered could effectively decrease this problem. Someone can be charged with the responsibility for seeing that all queries are answered. Whether there is a need for committing resources to this objective must be weighed in individual cases. In a conference developed to allow several scientists with similar backgrounds to share ideas, a formal arrangement would not be needed, although an active moderator might work hard to see that someone picks up the question, particularly in the early phases. On the other hand, in a more service-oriented conference, such as one organized to provide developing countries with practical information, resources to have questions answered by an expert might be built into the conference plan.

Other communication characteristics that participants in the conference would like to see changed have also been documented in other studies: content threads increase (four studies have shown this, and one was inconclusive), there is increased need for strong leadership (three studies have shown this, and two were inconclusive), it is difficult to focus discussion (seven studies have shown this, and one has concluded it was not a problem). These issues are highly interrelated. By content threads, Kerr and Hiltz mean the different conversations which become separated by other, intervening comments on a different subject. It is the multiple content threads that led so many respondents to ask for a more narrow topic for the conference. The problem with focusing discussion is, in part, a difficulty of the threads, but it is also a problem of getting respondents interested in a particular issue. "Leadership practices which emphasize clear organization and take advantage of some of the moderating control features offered by the computer, such as keywords, sequences of associations, or calling for a vote, can offset this problem and possibly lead to greater clarity than might be the case if single-issue discussions were enforced" (Kerr and Hiltz, p. 143, op. cit.). Thus, the need for strong leadership is apparent. "The lack of adequate leadership is one of the factors sometimes responsible for conference failure; unless a moderator sets an agenda and keeps the group working toward its goal, nothing much will occur. But the presence of strong and active leadership does not guarantee the success of conferences" (Kerr and Hiltz, p. 138, op. cit.).

Recommendations

The literature review indicates that the major concerns of the participants in this conference can be seen as a common difficulty with computer conferences, one that is unlikely to be changed unless a great commitment is made to the effort. The following section attempts to provide some suggested possibilities for increasing user satisfaction with the scientific content of computer conferences. The suggestions offered are oriented toward discretionary users — those who are not required by their job to involve themselves in the discussions. Active researchers are going to participate in a computer conference only if they derive career-related benefits from it. A scientific conference should provide scientific content that is useful to its participants and recognition for contributing to the proceedings. The suggestions made here would not necessarily apply to other types of conferences.

Selection of a Conferencing System

A reliable, easy-to-use system is needed. It should offer off-line editing and linkage to other conferencing systems. It does not need to have a high number of commands and special features; users do not seem to use them anyway. What is desirable, however, is automatic features to help keep the conference organized.

EIES, by default, presents information only in its temporal sequence. This occurs automatically when users check into the conference unless they override the default option to evoke the keyword system. Other systems allow the organizer to develop separate topic areas for the conference. When the participant signs in, all new information in a single topic area is presented sequentially. The participant is then asked to comment before the next area is presented. A system of this type should help to reduce the number of different threads that a reader needs to consider at once and perhaps even increase the focus of the discussion and the responses to items. The organization set up at the beginning of the conference is automatically maintained with little intervention from the moderator. Perhaps, if a

separate stream of nonscientific communication is available, those who like these aspects of the system can communciate without distracting from the proceedings for those interested in scientific communication.

It should be noted that COM does provide for separate topic areas. Unfortunately, because the comments had to be transmitted between COM and EIES and because the organization of the conference occurred through EIES, these features were not used.

Providing Technical Support to Users

Experienced computer users are much more likely to participate in a computer conference than novices. However, knowledge of computers is not high in the current generation of scientists unless their field is computer related. It is not a trivial task for an inexperienced computer user to connect a terminal to a modem and access a computer-conferencing system. Thus, the more support that can be provided to help the new user develop the required skills, the better. Good documentation and a resource person who can be called for technical help are a minimum requirement. A personal demonstration of how to use the system would also help. Overend's paper later in this volume discusses this problem in greater detail.

Establishing Ground Rules for the Conference

A number of the participants made comments that indicate that they would like the conference moderator to edit the organize the content of the proceedings. This is a good suggestion for a conference that will be judged for its scientific value and that wants to attract busy, prominent scientists to participate. On the other hand, authoritarian tactics can discourage participation, as described in the next section. Thus, any decision about the moderator's power might be an early decision of the participants — a good opportunity to use the conference's voting facility. Powers to be considered could include moving items (in the case where topics are separated) to a more appropriate topic area, improving the keywords, and deleting repetitious or inappropriate items.

Development of a Realistic and Useful Plan for Stimulating Discussion

What is involved in stimulating discussion in a computer conference is not entirely clear. However, Kerr and Hiltz (p. 81, op. cit.) differentiate between an authoritarian and an egalitarian approach. "An authoritarian leader's tendency to dominate the communication process is likely to decrease acceptance of the medium because of the reduced participation of others. The egalitarian leader appears to be effective in this medium. Generally, this leader encourages participation from all members, moves them to consensus, and includes all those interested in the formation of policy." Thus, along with providing background material or papers, a role for the moderator might be to pose questions.

A number of participants suggested that experts should be recruited to lead discussions, summarize, point to new directions, answer questions, and submit formal material. In this conference, co-moderators were recruited with these roles in mind. However, it is not easy to get busy experts to make the time for these types of activities. They may agree to take on a role but get sidelined by other activities. As reported by Fabricius in this document, only one of the co-moderators was active in this role. Perhaps a face-to-face discussion among the recruited leaders for the purpose of developing and putting introductory remarks into the

conference proceedings might ensure their familiarization with the conferencing system and increase their involvement.

Another suggestion for recruiting experts was provided on a participant's questionnaire. "Some off-line contact should have been made asking the expert to make some sort of statement, which should then have been entered into the proceedings. And the response to his statement should have been filtered back to him, so that he would have been aware of the potential of the system."

Providing Purpose and Focus

As mentioned in the literature review, a major determinant of participation in a computer conference is the perceived importance of the conference task to the participants. A small group working to plan a meeting or working to solve a specific problem of shared concern is much easier to manage than a more general scientific conference where the goals are less specific. Thus, a major problem for the conference leadership is to provide goals and projects that motivate participants to interact. Continual activity of the leaders in summarizing discussions and defining new problem areas is also required. However, as mentioned in the literature review, the types of activities that will most effectively meet these objectives are not known. In this conference, topic areas and topic summaries intended to stimulate discussion were provided in the opening remarks. However, discussion started slowly with many participants waiting to see if the conference were worthwhile. An approach similar to the dispersed December workshop in which groups of respondents gathered at a few major centres to provide a start to the proceedings might be a reasonably economical method to get a base of involved users actively involved early in the discussions. This would form a bridge from more conventional face-to-face contact to computer conferencing.

Providing Recognition for Participation

Those who are willing to provide information useful to a conference should benefit. If the conference content is generally useful to the scientific community, the published proceedings will fit into this category. Responding to good comments in the proceedings by the moderator or experts in the field is also a useful way of recognizing an interesting suggestion or contribution by a participant. Finally, the possibility of some face-to-face interaction with other participants might be considered.

Selecting a Moderator

The tasks falling upon the moderator of a scientific computer conference are overwhelming. Thus, the moderator should be willing and able to devote a great deal of time to his or her responsibilities. Arrangement of some release time from other responsibilities and clerical help would be very useful to conferences where strong leadership is required.

Summary

It is clear that funds and technical advancement are required to get the developing countries on-line in computer conferencing. In addition, many of the conference participants recognize the potential of the communication technology and would be willing to participate in future conferences. On the other hand, the level of participation and the quality of the contributions leave room for improvement in future conferences. While small, cohesive groups having a common goal may require little organization and leadership to direct their activities, this is not the case for a large scientific conference, particularly now and in the near future when the

majority of scientists in many disciplines are not experienced computer users. As one participant commented, "This conference was discouraging with respect to its scientific value. It is not enough that the communication is technically possible with the computer." Thus, the recommendations given in this section are concerned primarily with methods of improving participation and the quality of the information presented in the conference.

Appendix
Scientific Value Questionnaire

Your position _____ Date _____

Place an "X" in front of the conference topics that were of interest to you.

___ Upstream process
___ Food/fodder
___ Liquid fuels
___ Gaseous fuels
___ General
___ Other _____

If you selected more than one topic, please circle your major interest.

Directions: A number of statements are given below. Circle the number that best represents whether you agree or disagree with each statement.

	Strongly disagree					Strongly agree
I made new useful contacts through the conference.	1	2	3	4	5	
I got ideas for future research.	1	2	3	4	5	
I learned of techniques that could have practical application to problems in my country.	1	2	3	4	5	
I learned of published reports or references that I did not know before.	1	2	3	4	5	
I increased my general knowledge of the field.	1	2	3	4	5	
I was able to more easily reach people with whom I needed to communicate.	1	2	3	4	5	
The conference content was useful to my work.	1	2	3	4	5	
The conference changed my view of how my work relates to that of others working in the same subject area.	1	2	3	4	5	

Other benefits to you (list in the space provided):

If you entered comments into the conference, respond to the following items.
If you participated only as a reader, continue on the reverse side.

	Strongly disagree					Strongly agree
I feel that my contribution to the conference was recognized as significant.	1	2	3	4	5	
I contributed information which I consider useful to developing countries.	1	2	3	4	5	
When I submitted a comment or a question there was a satisfactory response from other participants.	1	2	3	4	5	

Directions: Circle the number that best represents whether you agree or disagree with each statement.

	Strongly disagree				Strongly agree
There was no one in the conference with whom I wanted to communicate.	1	2	3	4	5
The items I have received do not seem worth reading.	1	2	3	4	5
Other scientific activities must take higher priority.	1	2	3	4	5
The few benefits of this conference were not worth the time and effort involved.	1	2	3	4	5
The level of knowledge of participants was not sufficiently high for me to benefit from the discussions.	1	2	3	4	5
I am not interested in the topics being discussed.	1	2	3	4	5
Scientists from developing countries could gain nothing from the contributions and discussions.	1	2	3	4	5
Scientists from industrialized countrie nothing from the contributions and discussions.	1	2	3	4	5
Most participants were unwilling to share their ideas.	1	2	3	4	5
There was repetition in the comments.	1	2	3	4	5
I was reluctant to provide scientific information or scientific data in such an open conference.	1	2	3	4	5
I am concerned that some of the information provided might be inaccurate.	1	2	3	4	5

Other drawbacks for you (list in the space provided):

List any changes in the conference which would have significantly increased its value to you.

Conference Participation Questionnaire (On-Line Participants)

Directions: Circle the number that best represents whether the following factors were problems that limited or detracted from your participation.

	Not at all a problem					Major problem
Costs of participation.	1	2	3	4	5	
Difficulty in obtaining approval to participate.	1	2	3	4	5	
Administrative difficulties.	1	2	3	4	5	
Difficulties with access to a computer terminal.	1	2	3	4	5	
Difficulty with the telecommunications link.	1	2	3	4	5	
Lack of technical assistance in learning to operate the system.	1	2	3	4	5	
The instructions on how to use the conferencing system were difficult to understand.	1	2	3	4	5	
Using a computer conference to communicate is complicated.	1	2	3	4	5	
Lack of experience with computers.	1	2	3	4	5	
The need to be able to type to enter my comments.	1	2	3	4	5	
The need to be able to read and/or write in English.	1	2	3	4	5	
Lack of face-to-face contact.	1	2	3	4	5	
Possibility of reduced opportunities for international travel.	1	2	3	4	5	
Dislike of using a computer to communicate.	1	2	3	4	5	
Too much information.	1	2	3	4	5	
Difficult to find the comments of interest to me.	1	2	3	4	5	
Lack of response to contributions.	1	2	3	4	5	
Lack of facility for off-line editing.	1	2	3	4	5	
Lack of graphics and/or mathematical symbols.	1	2	3	4	5	

Other factors that limited your use:

If you encountered serious technical difficulties, please describe:

Directions: Circle the number which best represents how important the following factors were in encouraging your participation in the conference.

	Not at all important					Very important
I could participate when convenient.	1	2	3	4	5	
Participation did not interfere with other activities.	1	2	3	4	5	
A written record of the conference is available.	1	2	3	4	5	
It is faster than using the mail service.	1	2	3	4	5	
It is less expensive than traveling.	1	2	3	4	5	
I had a chance to express myself less formally than in a publication.	1	2	3	4	5	
I could think over my response before answering.	1	2	3	4	5	
No one could interrupt my comments.	1	2	3	4	5	
There is less chance of misunderstandings.	1	2	3	4	5	
I enjoyed using the computer.	1	2	3	4	5	
I learned a new way of communicating with colleagues.	1	2	3	4	5	
I could communicate with colleagues in many parts of the world at a uniform cost.	1	2	3	4	5	

Other factors encouraging your use:

If you were invited to participate in another computer conference on a topic of interest to you in the near future do you feel you would participate?

___ Yes ___ No ___ Uncertain

Why?

Approximately what percentage of the conference proceedings did you read?

___ Less than 25% ___ 25% to 49% ___ 50% to 74% ___ 75% or more

---

Your level of participation as a contributor to the conference was

___ Regular ___ Occasional ___ Not at all

Did someone else use the system to take printouts for you and type your contributions to the conference?

___ Always ___ Sometimes ___ Never

Conference Participation Questionnaire (Off-Line Participants)

Directions: Circle the number that best represents the extent to which the following factors were problems that required you to participate in the conference off-line via telex and/or mail.

	Not at all a problem					Major problem
Costs of participation.	1	2	3	4	5	
Difficulty in obtaining approval to participate.	1	2	3	4	5	
Administrative difficulties.	1	2	3	4	5	
Difficulties with access to a computer terminal.	1	2	3	4	5	
Difficulty with the telecommunications link	1	2	3	4	5	
Lack of technical assistance in learning to operate the system.	1	2	3	4	5	
Using a computer conference to communicate is complicated.	1	2	3	4	5	
Lack of experience with computers.	1	2	3	4	5	
The need to be able to type to enter my comments.	1	2	3	4	5	
Other factors requiring off-line participation:						

Directions: Circle the number which best represents whether the following factors were problems that limited or detracted from your participation.

	Not at all a problem					Major problem
Lack of face-to-face contact with participants.	1	2	3	4	5	
The need to be able to read and/or write in English.	1	2	3	4	5	
Possibility of reduced opportunities for international travel.	1	2	3	4	5	
Too much information.	1	2	3	4	5	
Difficult to find the comments of interest to me.	1	2	3	4	5	
Lack of response to contributions.	1	2	3	4	5	
Lack of graphics and/or mathematical symbols.	1	2	3	4	5	
Other factors which limited your use:						

Directions: Circle the number that best represents how important the following factors were in encouraging your participation in the conference.

	Not at all important					Very important
I could participate when convenient.	1	2	3	4	5	
Participation did not interfere with other activities.	1	2	3	4	5	
A written record of the conference is available.	1	2	3	4	5	
It is faster than using the mail service.	1	2	3	4	5	
It is less expensive than traveling.	1	2	3	4	5	
I had a chance to express myself less formally than in a publication.	1	2	3	4	5	
I could think over my response before answering.	1	2	3	4	5	
No one could interrupt my comments.	1	2	3	4	5	
There is less chance of misunderstandings.	1	2	3	4	5	
I learned a new way of communicating with colleagues.	1	2	3	4	5	
I could communicate with colleagues in many parts the world at a uniform cost.	1	2	3	4	5	
Other factors encouraging your use.						

If the technical difficulties could be solved, would you prefer to participate in the conference on-line instead of by telex and/or mail?

___ Yes ___ No ___ Uncertain

If you were invited to participate in another computer conference on a topic of interest to you in the near future do you feel you would participate?

___ Yes ___ No ___ Uncertain

Why?

Approximately what percentage of the conference proceedings did you read?

___ Less than 25% ___ 25% to 49% ___ 50% to 74% ___ 75% or more

---

Your level of participation as a contributor to the conference was

___ Regular ___ Occasional ___ Not at all

Conference Participation Questionnaire (Nonparticipants)

Directions: A number of factors are given below. Circle the number that best represents whether the following factors were problems that prevented your participation in the computer conference.

	Not at all a problem					Major problem
1. Did not know about conference.	1	2	3	4	5	
2. Lack of interest in the proposed topics.	1	2	3	4	5	
3. Other scientific activities took higher priority.	1	2	3	4	5	
4. Costs of participation.	1	2	3	4	5	
5. Difficulty in obtaining approval to participate.	1	2	3	4	5	
6. Administrative difficulties.	1	2	3	4	5	
7. Difficulties with access to computer terminal.	1	2	3	4	5	
8. Difficulty with the telecommunications link.	1	2	3	4	5	
9. Lack of technical assistance in learning to operate the system.	1	2	3	4	5	
10. Using a computer conference to communicate is complicated.	1	2	3	4	5	
11. Lack of experience with computers.	1	2	3	4	5	
12. Dislike of using a computer to communicate.	1	2	3	4	5	
13. The need to be able to type to enter my comments.	1	2	3	4	5	
14. The need to be able to read and/or write in English.	1	2	3	4	5	
15. Lack of face-to-face contact.	1	2	3	4	5	
16. Possibility of reduced opportunities for international travel.	1	2	3	4	5	
17. There was no one in the conference with whom I wanted to communicate.	1	2	3	4	5	
18. I was reluctant to provide scientific information or scientific data at such an open conference.	1	2	3	4	5	

Other problems (list in the space provided):

Which of the above factors was most important in your decision? (Give numbers.)

What possible factors might have motivated you to participate in this conference?

A Content Analysis of the Conference Proceedings

Björn-Olof Fabricius[1]

The computer conference on the bioconversion of lignocellulosics for fuel, fodder, and food on COM and the Electronic Information Exchange System (EIES) during 1983 had two primary objectives: (a) on the scientific side, to explore the possible uses of bioconversion of lignocellulosics for development purposes, because this is of importance for the optimal management of the renewable resources of the developing countries; and (b) on the technical side, to explore the viability of using computer conferencing for communication within a specific user group, with emphasis on the needs of the developing countries. This evaluation analyzes the proceedings and discusses some scientific aspects of the conference.

Structure of the Conference

The conference was started at the beginning of May on both COM and EIES. During the first months, some of the messages were tranferred between the systems manually by participants who used both systems. The decisions on which texts to be transferred were made by these users. During this stage, personal messaging between the two systems was not possible. As the techniques for message transfer developed during the exercise, the text transfer was gradually automated, and all the texts entered in one of the systems were transferred to the other system. According to the initial plans, the conference in EIES (Bioconversion of Lignocellulosics) was planned only for 6 months, whereas the parallel conference in COM (Bioconversion Technical) was announced to continue until the end of 1983.

Both conferences had a moderator, who was the overall chairman of his conference. The two conferences were split into a set of subtopics (see the section on Topic Areas). Each subtopic also had a co-moderator in both systems used.

A synchronized phase with coordinated activities at several sites around the world was planned at an early stage for mid-December, but the announcement of this part of the conference was presented to the users in COM earlier than to the users in EIES. This probably affected the rates of activity of the two user groups. During this phase, a set of face-to-face meetings was held at different nodes. These groups discussed a few specific topics each day during 1 week. Summaries of the discussions were then entered daily into the computer conferencing systems.

[1] Department of Microbiology, University of Helsinki, USF 00710 Helsinki 71, Finland. (Research reported here was funded by the United Nations University.)

Individual scientists participated asynchronously in the discussions using their own terminals (on-line participants) or through mail or telex (off-line participants).

Evaluation Methods

The scientific evaluation was carried out by examining texts entered into the two parallel conferences (Bioconversion of Lignocellulosics in EIES, and Bioconversion Technical in COM). Notes on each text were entered into a microcomputer-based data base. The notes made about each text contained the following:

- Original text number,
- The synonymous text number in the parallel system (if known),
- The month when the text was entered into the conference,
- The text numbers of the texts that were commented upon,
- Actual keywords from the text with special emphasis on questions and answers to these questions and on the commenting of other texts,
- A statement (true or false) on whether the text was scientific or not, and
- A statement (true or false) on the match of the keywords used in the header of the text to the actual text contents.

A total of 574 texts were examined, of which 327 originated from the COM system and 247 from the EIES system. The texts examined are the texts originating in EIES or transmitted to EIES from COM during the period 1 April 1983–16 December 1983. Most of the texts can be found in "Computer Conference on Bioconversion of Lignocellulosics for Fuel, Fodder and Food, Conference Transcript, IDRC, 1983."[2]

The data base was checked and corrected for misspellings using a spelling-checker and a word frequency count program and then used for analyzing the text contents, the use of keywords, the questioning and answering, and for cross-referencing texts and comments to these texts.

An evaluation questionnaire was planned by an evaluation planning group. One part of the questionnaire dealt with the scientific aspects of the conference exercise. The comments received in the scientific value questionnaire have been taken into account when writing this report.

The needs and problems of the developing countries and of international networks such as the MIRCEN (Microbiological Resource Centres) network were looked into by personal communication to some key participants from developing countries and from the MIRCENS. The comments in the questionnaires and the comments made on these specific topics during the conference were also considered.

[2] Information Sciences Division (IDRC). 1983. Computer conference on bioconversion of lignocellulosics for fuel, fodder and food. Transcript of an international computer conference held 2 May–31 December 1983. International Development Research Centre (IDRC), Ottawa, Canada. 331 p. (Mimeo)

Results from the Analysis of the Data Base

Scientific vs Nonscientific Texts

Definitions

One of the aims of this evaluation was to find out to what degree scientific matters were discussed during the conference. The use of the terms "scientific" and "nonscientific" to describe the text contents is more or less subjective. The notes made while making up the data base on whether the texts were scientific or nonscientific adhered to the following principles:

- Only texts discussing matters related to the scientific conference topics (see the section on Topic Areas), adding new information or drawing conclusions based on old information of a scientific nature, were considered as "scientific texts."
- To put more emphasis on fresh and new information, repetitious texts that could be considered as redundant information were labeled as "nonscientific" even though they might contain scientific information.
- Texts discussing the use of computer conferencing, its future implications, problems related to its use, etc., were considered "nonscientific."
- Texts announcing conferences, symposia, articles, publications, etc., were considered "nonscientific."
- Texts consisting of short presentations of participants or groups of participants lacking scientific information on the participant's research projects were considered "nonscientific."
- Texts consisting of requests of equipment, strains, reprints, etc., were considered "nonscientific."

Some texts that were clearly intended to be sent as private messages were probably entered into the public conference by mistake. These texts were handled and labeled according to the principles already mentioned. These principles made it possible to separate the real scientific discussions from the part of the conference that, from a participating scientist's point of view, could be considered as "redundant information." The real "corridor talk," private exchange of scientific information through private messaging, was not included in this evaluation because no information was available on that part of the conference.

Results

The number of scientific and nonscientific texts entered is presented in Table 1. The pattern seemed to be the same in both systems — only about half of the texts written dealt mainly with the scientific topics of the conference. Twenty-one texts involved off-line participants (submitted by off-line participants or commenting texts written by on-line participants).

Table 1. The number of scientific and nonscientific texts entered during the conference.

	COM		EIES	
	Amount	%	Amount	%
Scientific texts	161	49	127	51
Nonscientific texts	166	51	120	49
Total	327	100	247	100

The monthly activity in COM and in EIES (Table 2) differs, probably due to the fact that the EIES activity originally was planned to cease by the end of the September, whereas the COM activity was scheduled until mid-December. The actual number of texts entered into COM during June–September is larger than the number of texts transmitted to EIES. It has to be remembered that this report only deals with the texts transmitted to or written in EIES. In COM, the December activity accounts for 75% of the texts, but only 30% of the texts in EIES were written during December. No significant change in the monthly levels of scientific vs nonscientific activity can be seen during June–December.

Comments, Questions, and Answers

One prerequisite for an efficient and fruitful scientific discussion is that entries are commented on by other scientists and that questions are answered. Thus a special emphasis was put on analyzing the comments, questions, and answers during the conference.

Texts Commenting on Other Texts

The number of texts commenting on other texts is COM 167 and EIES 120, with 44 and 68 calculated as the percentage scientific for COM and EIES, respectively. A difference in the commenting pattern in COM and in EIES can be seen from the number of scientific texts commenting on other texts. The discussion in EIES seems to be more focused on the scientific aspects than the discussion in COM. About 50% of the total amount of texts contained comments to other texts.

Many texts contained multiple comments to several other texts. That is to say that an individual would have read more than one text and then commented on all of them in a single entry. An overview of this type of commenting is as follows. The number of texts commenting upon one or more commented texts (all texts included): one text commented, 197; two texts commented, 53; three texts commented, 16; and four or more texts commented, 21.

Texts Commented in Other Texts

The number of commented texts in COM was 56 scientific and 76 nonscientific, equivalent to 35% and 46% of the respective totals. The number of commented texts in EIES was 72 scientific and 63 nonscientific, equivalent to 57% and 53% of the respective totals. About 47% of the total number of texts written have been commented on. The EIES texts are generally more commented upon than the COM texts. The scientific and the nonscientific EIES texts are equally commented, whereas the scientific COM texts are less commented than the nonscientific COM texts.

Table 2. The monthly activity in COM and in EIES. Number of texts and percentage of scientific texts entered during the period June–December.

	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COM							
Total number	2	4	10	20	18	21	248
Percentage scientific	100	50	60	55	44	66	47
EIES							
Total number	15	42	29	26	16	14	73
Percentage scientific	40	52	51	61	56	57	52

Several texts were commented upon by more than one individual, that is to say, some texts evoked a response from several other participants. The number of comments to commented texts of all texts included is texts commented on once, 175; twice, 63; three times, 16; four times, 9; and number of texts commented on more than four times, 4.

A total of 14 texts that were considered as "extended abstracts" or "500 word summaries" were entered during the conference. These texts were meant to be lead papers around which the discussions could focus. Of these texts, four started off a discussion, three were commented upon but did not start off any discussion, and seven were never commented upon.

Questions

Evident questions occurred in a total of 112 texts, which account for about 20% of the total number of texts. The number of texts containing questions is 62 in COM, 94% of which were scientific, and 50 in EIES, 84% of which were scientific. Most of the questions were dealing with scientific matters. The few questions asking about nonscientific matters mainly dealt with communication problems.

Answers

The results of the analysis of answers given to questions in this computer conference are: number of texts containing answers to previous questions is COM 22 with a percentage scientific of 68 and EIES 30 with a percentage scientific of 87. The number of texts that contained questions that were answered is COM 17 with a percentage scientific of 82 and EIES 15 with a percentage scientific of 87. About one-third of the scientific questions (27 texts of 100) and five texts of 12 of the nonscientific questions were answered.

Use of Keywords

The conference was divided into a set of subtopics, although the two systems used did not allow the users to write their comments into a separate "topic area" within the conference. Thus, it was difficult to read only the comments belonging to one of the subtopics. Both COM and EIES have facilities for writing keywords (subject headers) on the text and to scan only those keywords to find texts of interest. This means that the author of the text had to be thorough about the use of accurate keywords to enable efficient use of the conferencing systems. The match of the keywords to the actual contents was analyzed. The number of texts with matching keywords in COM was 207, representing 63% of the total, and 189 in EIES, representing 77% of the total. With respect to scientific texts, 94 of the COM texts, representing 58% of the total COM scientific texts, and 97 of the EIES texts, representing 76%, were keyworded appropriately.

The use of accurate keywords was better in EIES than the use of subject headers was in COM. This is probably because of the difference in system design; in COM the subject headers are entered before the text is written, but the keywords in EIES are entered upon finishing the writing of the text.

The transfer of texts between the two systems provided some problems and peculiarities with respect to keywords and to the possibilities of commenting on other texts because the two systems involved handle these things in different ways. In COM, a text can be commented upon using the command "comment,"

which automatically provides the text with the subject header of the commented text, and a statement "comment on text nnnnn." These series of texts form "trees" and it is possible to read a text and all its comments as a sequence. A text written on EIES as a comment to a text originating from COM was transmitted back to COM as a new entry, which meant that it was impossible to track down a complete sequence of texts and their comments. A comparable problem occurred when comments to EIES texts were transmitted to COM.

Several COM texts were transmitted to EIES together, which meant that they all occurred under the same text number and with the same keywords in EIES. Usually, the texts transferred to EIES this way belonged to the same "tree" of discussion in COM, but some texts were entered into EIES using keywords that had nothing to do with the actual text contents. As an example, a text explaining how to "scan" the subject headers and the keywords of the texts to avoid information overload occurred in EIES under the header "gaseous fuels."

Topic Areas

The conference was subdivided into five subtopics. All these subtopics were not of equal interest. No exact figures for the number of texts dealing with a specific subtopic were tabulated because many texts dealt with several topic areas. The scientific discussion seemed to be focused on the topic areas as follows (rated from the most discussed to the least discussed) upstream process considerations, processes for liquid fuels, processes for food/fodder, general considerations, and the least discussed, processes for gaseous fuels.

The most common topics of the nonscientific texts were as follows: presentations of participants, groups of participants, research projects in 58 texts; requests for equipment, strains, reprints in 40 texts; computer conferencing in general in 36 texts; greetings and other private messages in 30 texts; the future of the ongoing computer conference exercise in 19 texts; and announcements of congresses, symposia, new publications, fellowships in 14 texts. Problems related to the developing countries and the applications suitable for those countries were discussed in a total of 60 texts. Of these texts, 37, or about 13% of the total number of scientific texts, discussed scientific aspects.

Discussion

The computer conference on the bioconversion of lignocellulosics for fuel, fodder, and food was initiated as an experiment in the use of computer conferencing to enhance the communication among scientists in various parts of the world. The high number of participants and their geographical and disciplinary distribution turned this exercise into an interesting experiment. More than 100 scientists were involved in the exercise. This conference was the first exercise of its kind within the microbiological scientific community and many problems that occurred were probably due to the fact that the participants were unfamiliar with this medium. Better user manuals and individual guidance might have decreased these problems.

The conference was of great interest to many parties because the topics discussed are areas of priority and cooperation between both developing and

industrialized countries. But, because of the large number of scientists involved, the topic turned out to be too broad.

The number of texts dealing with the scientific topics of the conference was only half of the total number of texts. The large number of nonscientific texts was one of the reasons for complaints about information overload that occurred during the conference and in the comments on the evaluation questionnaires. Scientists who want to attend a conference on a topic of interest to the scientific work that they are doing cannot afford to spend half of the time reading texts of no scientific value. In general, the quality (technical and scientific) of the texts entered into the conference varied widely. Also the length of the texts varied widely. These factors are dependent on the personalities of the participants, but, because of the costs involved with message transfer and printout, they have to be considered important.

In many cases, the contents of the scientific texts show that participants were reluctant to provide new scientific information. Many scientific texts, among them most of the 500-word summaries, were reviews of previously published material. These texts may not be of great interest to participants from industrialized countries where the libraries contain many international journals, but to participants from the developing countries, where the journals are not always readily available, probably they are as interesting as texts containing unpublished information.

Because of the design of the computer-conferencing systems used, it was difficult for individual scientists to follow the discussions within the subtopic(s) of interest to them. The special problems that occurred because of the use of two different systems increased these difficulties. Scientists working within the different subtopic areas were not equally represented among the participants and, thus, the discussions were more focused on some topics than on others. Because of the system design and because of the lack of experience with the system, and with the use of accurate keywords, many users were reading not only the texts of particular interest but all texts entered into the conference. This can be considered as an unnecessary waste of time and money, and several comments on the questionnaire responses dealt with these problems.

Less than half of the scientific texts written in COM and about half of the scientific texts written in EIES were commented upon by other participants and only about one-third of the scientific questions that were asked during the conference were ever answered. This shows that the scientific discussion was not very active. Many participants were disappointed because of the lack of response to the texts entered.

The role of the moderator of any meeting is important. This conference suffered from the lack of active co-moderators for the various subtopics. In fact only the moderator of the conference carried out in EIES was actively participating, commenting on texts, and encouraging participants to be active.

One of the main goals of the conference was to explore the use of computer conferencing as a means of technology transfer between the industrialized and the developing countries. Because of the many problems involved with access to computers and to functioning computer networks that the scientists in developing countries were facing, only a few scientists from the developing countries were able to participate actively, and, thus, the potential of computer conferencing for this purpose was very difficult to evaluate.

Conclusions

From a scientific point of view the conference could not be considered as a clear-cut success, especially to participating scientists from the industrialized countries. It has to be remembered though, that this conference was an experiment and that the experience gained during the conference can be used in the planning of future activities.

The reasons for the conference not being a clear-cut success from a scientific point of view are manifold. In many cases, the reasons are to be found in the structure of the conference and in the fact that most of the participants were unfamiliar with the use of this communication medium. The use of two different conferencing systems was confusing for the sequences of texts and comments. The design of the two systems partly allowed the participants to avoid information overload, but this facility was not very useful because of the underutilization of headers and keywords. All the texts, scientific, and nonscientific, were entered into the same conference, which contributed to the information overload.

The focus of future conferences should be better organized (e.g., split up into separate subtopic conferences), and a separate conference should be used for the nonscientific communication. The moderators of the conferences have to be active in the conferences, checking texts for the use of correct keywords, moving texts if they have been entered into the wrong conference, directing the focus of the discussions, and encouraging participants to participate actively.

Effective information about the activities is essential. This includes preconference information and on-line and off-line information during the conference.

The reluctance to provide unpublished scientific information is a problem that is not very easy to solve. This reluctance might decrease partly if more scientists get acquainted with the system and if the scientific level of the contributions can be raised.

One important aspect for any scientist is that the information provided in the conference entries is correct. This leads to the "quality problem." It is difficult for a participant to know whether the texts written by other users are based on knowledge and experience or not. Articles published in international journals are usually reviewed by experts before publishing, but in a computer conference anyone can contribute anything. The only censorship automatically existing in a computer conference is the review of the texts made by every individual participant. Thus it is important to involve enough experts in any scientific computer conference to secure the scientific level of the conference or to include some other way of censoring texts before they are entered. One drawback of including censoring of texts in a scientific conference in the increased bureaucracy that eventually might lead to a decrease in spontaneous discussions. The importance of the quality factor should not be emphasized too much though, because to many participants the possibility of having an informal communication with other scientists is the main motivation for participating.

The problems faced by participants from the developing countries show that a significant effort must be put into the development of communication links and computer link-up in these countries to facilitate future use of computer conferencing as a means of communication. The need for this kind of communication

is greater in the developing countries than in the developed world because of the possibilities of day-to-day guidance from experienced scientists that it could provide. Good organization for off-line participation must be considered when plans are made for future exercises. This is an extremely important factor, because if it is not done properly there is a danger of widening the gap between scientists in the industrialized world and scientists in the developing countries.

The use of computer conferencing for scientific conferences in the life sciences is a new and interesting approach. The potential of computer conferencing for international information transfer is evident, but there must be functioning communication links before it can be effectively utilized. It seems to be difficult to maintain an open scientific discussion in a computer conference, and the success of the conference is extremely dependent on the activities of the organizers and moderators. In this sense, computer conferences do not differ from ordinary scientific meetings, but the effect is more pronounced. The best cost–benefit from the use of this medium for the transfer of scientific information is probably obtained when it is used within groups or networks of scientists having a clearly defined need for fast and efficient communication.

Evaluation of the Communication Mode

John B. Black[1]

In summary terms, from a technical perspective, the 1983 computer conference on the bioconversion of lignocellulosics must be considered a success. This is not to say that there were no technical problems or complications. However, in general terms, the systems involved performed in a reliable manner such that technical considerations were not generally a stumbling block to successful participation in the activity. Not surprisingly, given the fact that even the use of a simple terminal was new to many of the participants, there were a number of individual cases of frustration, difficulty in gaining access, transmission problems, microcomputer operational difficulties, and related technical problems, but in general terms the communications technology aspects went well. As had been anticipated in advance, the one basic and central technical problem that did clearly affect participation was the difficulty (or in some cases the impossibility) experienced by some scientists in developing countries in gaining access to the international data-communications networks.

The decision to choose two well-established computer-conferencing systems as the hosts for this conference largely eliminated the basic host computer-conferencing system as a variable in the successful running of the activity. Both the Electronic Information Exchange System (EIES) and COM are mature systems with solid network access links and several years experience running large computer-conferencing activities. Although both systems underwent some hardware, software, or network access changes during the conference, these alterations did not provide any significant interruption to the conference itself.

In the report to follow, a number of specific technical issues will be identified and addressed along with some related human interaction problems, legal/political/regulatory issues, and the always present question of financial implications.

Technical Problems Identified

(a) Network access (or more specifically, the lack of it) proved to be a major problem for many would-be participants from developing countries and even some in certain industrialized countries. In many developing countries, direct access to the international data networks was simply not available and the alternatives (e.g., direct long-distance voice-line telephone calls to the nearest data network node) were either too expensive or unreliable or both. Although while this situation is improving with some rapidity (e.g., see Appendix 1 for a list of current Telenet access locations) developing-country scientists still face some major obstacles in

[1]McLaughlin Library, University of Guelph, Guelph, Ontario, Canada N1G 2W1. (Research reported here was funded by the United Nations University.)

this regard when they contemplate using computer conferencing as a regular research communications tool. Even in the case of some industrialized countries, such as Japan, major difficulties were experienced by participants who attempted to use international access arrangements that were supposed to be in place.

(b) The local telecommunications links into the international data networks also proved to be an area of potential (and real) difficulty for many developing-country participants, particulary those located outside the capital or other major cities. In some cases, the infrastructure simply did not exist (e.g., one participant had to travel 1 hour by car to reach a location with a link to the networks) or reliability was so low as to make regular use of the facilities difficult, discouraging, or impossible.

(c) A number of other local data-access or terminal-related difficulties were reported by participants in response to the general questionnaire. These included unreliable terminals, complexity of still evolving modem/network standards, lack of information on or understanding of particular technical requirements (e.g., Bell 103 vs CCITT modem standards), microcomputer hardware problems, micro-computer communications software problems, lack of training in use of the equipment, and lack of experience in use of terminals, microcomputers, or data networks.

All of these contributed to a feeling of frustration and a lack of regular participation by some of those who had intended to be involved in the conference on a regular basis. Although specific examples of the difficulties encountered by participants in this exercise could be given, it is more useful to recognize the areas that would require particular attention in any future endeavour. Given the rapidly changing technologies involved, the specifics will certainly have changed in the interval since the conference, but the areas identified already highlight some of the potential difficulties.

(d) Conducting the conference on two host systems introduced some technical complications, particularly for the conference organizers. This was especially the case during the synchronous phase in December. Initially, the transfer of conference entries from the EIES-based conference to the COM-based activity was done entirely manually through the use of a microcomputer as a transfer vehicle. Conference entries from EIES or COM or both were downloaded to disk files on a microcomputer, slightly edited to remove any characters (including blanks in the wrong place) that would confuse the other system (such as the " - - - - - " line in COM entries that on uploading to EIES caused the system to log the user off), and then loaded into the other host by entering its editor program and uploading the message or conference comment. Maintaining the individual nature of conference messages and attempts to provide appropriate links to other related comments made this a complex, laborious, and time-consuming task. During the course of the conference, the initial methodology was improved on by the COM system operator and, toward the end of the activity, the access to the intersystem MAILNET facility was implemented, further improving the transfer operation.[2] This facility, how-

[2] In the spring of 1984, the Stockholm-based QZ computer centre (COM's homebase) began to offer a service to the United States based EDUNET educational computing consortium members to provide home delivery of COM mail and conference entries to the participants' local computer facilities

ever, has not been fully implemented for conference messages (as opposed to personal messages) and the problem clearly illustrates the still developing state of the art in computer conferencing. Although the situation is improving, much remains to be done.

(e) Individual participants appeared to have varying degrees of success in creating conference comments and messages on their local microcomputer systems and then subsequently uploading them to EIES or COM or both. The problems encountered included:

- Complications introduced by particular characteristics of the international data networks and a lack of understanding by many users of the very complex network parameter settings sometimes required to facilitate such transfers;
- Lack of experience, familiarity, and confidence with the microcomputer communications software being used to upload/download the data; and
- Misunderstandings about the sequences required to interact with the host systems to complete these functions successfully.

It is evident that streamlining this aspect of the process would ease the frustration level of many participants in the future and enhance their effective use of both telecommunications networks and host systems. At low transmission speeds (e.g., 300 baud) the actual cost savings are relatively limited, but the opportunity to use local (and generally much more familiar) editing systems for the creation of conference entries is a great advantage.

(f) The lack of a means of displaying graphics and special symbols proved to be a problem for some participants. Even relatively simple tables represented a complex data input task because no assumptions could be made about the capabilities of the terminals that might be used to access the system. Use of special graphics characters, formatting commands, cursor positioning codes, and other such display tools were eliminated. In addition, particular implementations of the American Standard Code for Information Interchange (ASCII) code occasionally provided some confusion for other participants (e.g., some of the characters used on Scandinavian terminals produced unexpected characters on U.S. terminals and vice versa).

(g) "Information overload" was a term that appeared from time to time in the conference itself and in questionnaire responses, particularly with reference to the December "synchronous phase." From a technical perspective, this clearly indicates the need for simple to use but more sophisticated information retrieval software tools to enable participants to cope with the volume of material that can appear in a very active conference. The existing search and retrieval tools available on the two host systems did not appear to be able to meet the perceived needs of many participants who did not develop sufficient fluency with the host systems to exploit fully the tools available to them (e.g., the "tree" command in COM).

---

through MAILNET. In this way new entries in COM conferences to which an EDUNET participant is registered can be delivered automatically through MAILNET. Similarly, comments can be entered into COM conferences directly by transferring them through MAILNET to COM. EDUNET News, 31 (Spring 1984), p. 2.

Human Factors Related to Technical Aspects

Although the human aspects of the conduct of this computer-conferencing activity are being discussed in detail elsewhere, there are a number of human dimensions that are very closely related to the technical aspects under discussion here. These include:

(a) An apparent lack of computer literacy on the part of many participants was illustrated by their inexperience in the use of terminals, microcomputers, networks, or electronic messaging systems, let alone previous experience with computer conferencing systems per se. At the same time, it was evident that many of these same participants were very anxious to use this opportunity to develop their own knowledge and experience in this area and approached this exercise in a very positive fashion.

(b) The need for more (and better) manuals and training aids was also evident in the questionnaire responses. Some apparent inaccuraries in the manuals supplied for this conference were reported, but, more important, a number of participants touched on the need for a more extensive (and in some cases more basic) range of manuals and documentation as well as some training sessions for prospective conferees.

(c) The lack of local support systems related to the technical aspects of the conference was evident in the case of many participants. This was particularly true for some of the developing-country participants who were faced with situations where there was very limited local support or expertise available in this field. Surprisingly, at least to this evaluator, the same problem was also reported by some industrialized-country participants. To quote one frustrated respondent from a major United States university, "I work surrounded by so called computer experts. I was rarely able to gain help from them. They were just too busy." It is thus apparent that from the point of view of the technical use of the system, the successful conduct of a computer-conferencing activity is very dependent on the existence and ready availability of good training/operations materials, handholding and local support, and the regular reinforcement of the participants developing skills. Without considerable attention to this aspect, the likelihood of a successful conferencing program is much reduced.

(d) In the context of support systems, the essential role of the communications manager or facilitator in an activity such as this one became increasingly apparent in retrospect. As part of the broader support system, this person (or persons) must be readily accessible to provide assistance, advice, handholding with regard to the host conferencing system, communications networks, terminals, modems, microcomputers, communications software, and, most important, the interconnection and interaction of all of these. More than just technical information and knowledge is required, as such a facilitator must also have: a sympathetic view of the technologies involved; an understanding of human communications processes; broad communications skills; the ability to deal with a wide range of user experience, skills, and personal inclinations; time to deal with problems as they arise and to ensure that users feel there is someone approachable; and the facilities to be accessible to all types of users, by whatever means.

The obverse of this support system should also be noted, participants must be willing to take the time and make the effort to contact the support people who are available. Like most other aspects of human communications, this must be a two-way flow.

(e) The decision was made to operate the bioconversion of lignocellulosics conference as an "open conference" accessible to any user of either host system rather than as some sort of limited access discussion. It is probable that this open atmosphere had some impact on the kinds of discussion that took place (or did not take place) and other alternative formats should be kept in mind for future conference activities. COM provides facilities for public (open) conferences — any user of the system can join, private (closed) conferences — the organizer must enroll the users he or she wishes to admit, restricted — only a certain group can join, and protected — nonmembers cannot even get information about the existence of this conference.

EIES has similar arrangements for public conferences — anyone can join, private conferences — the moderator must enrol the user, and group conferences — membership based on group identification (ids) plus others enrolled by the moderator.

Thus, a number of alternative arrangements are possible to meet the specific requirements of a given conferencing situation and must be considered thoroughly when establishing a conferencing activity.

Political/Legal Issues Related to Technical Aspects

In the context of the technical aspects of the conduct of this computer conference, two political/legal aspects surfaced with some regularity, particularly, but by no means exclusively, in regard to developing countries.

(a) At the governmental level there are a number of political or legal barriers that appear to inhibit access to the international data networks. These took a number of forms including an apparent lack of interest in developing the necessary telecommunications links, excessive or tardy bureaucratic mechanisms for making the appropriate arrangements even where direct technical problems were not a barrier, and the presence of regulations regarding the movement of data within a nation or across international borders.

(b) In many states the telecommunications authorities (usually a government department, state-owned corporation, or other state agency) maintain very rigid control over who can connect what device to the telecommunications network. In some cases, this simply inhibits connection to international telecommunications networks or increases the operating costs. In other cases, these same controls are used to block access to international data networks and services.

(c) A related problem appeared in the form of organizational bureaucracies that inhibited participation even when the direct technical telecommunications access problems had been sorted out. For example, one organization apparently took most of 1983 to straighten out the arrangements for funding for its scientists to participate, by which time the conference itself was virtually over.

Financial Problems

The high cost of systems access and telecommunications was perceived as a problem by many participants, particularly (but not exclusively) those outside the United States. The cost factors involved included: terminal devices and modems, microcomputers and modems, telecommunications, and host-system costs.

The normal EIES monthly charge (US$75.00) was cited as being too expensive (even though alternative arrangements for a usage-based fee had been made for this conference) and the cost for use of the international data networks to reach the host systems was also mentioned in questionnaire responses. For developing-country participants, the lack of direct access to the international packet-switched data networks compounded this problem because it necessitated direct long-distance voice-line telephone calls that were very expensive as well as often being unreliable.

Appendix 2 and Appendix 3 provide some indication of the costs involved in accessing COM and EIES during the period of this conference. For those participants (or would-be participants) without direct access to the international packet-switched data networks, the costs were dramatically higher owing to the necessity of using regular, voice-grade long-distance telephone lines to get to the nearest data-network node. Costs of $1.00 to $5.00 per minute are routine for this type of access and obviously have a considerable impact on the viability of computer conferencing as a worldwide communications and information exchange medium.

Conclusions

A number of general conclusions can be made regarding the technical aspects of this international computer-conferencing activity, and it is clear that the experience gained will provide useful guidance to future conference planners.

(a) The host systems used were reliable and did provide a sound technical basis for the conference activity. Some individual problems with use of the host software were encountered, but often these were due to a lack of training, documentation, or experience. The host systems, per se, were not barriers to participation. Running the conference on two host systems did provide some added technical complications, especially for the conference organizers, and the need for the development of simple and effective intersystem links is indicated very clearly.

(b) The international data networks were largely reliable, where access to them existed. Difficulty of gaining access to these networks, however, highlighted the problem faced by scientists in many developing countries (e.g., Guatemala, India, or Kenya). Even when the access was theoretically available, actually using it was sometimes another matter. The difficulties experienced by participants in Japan, for example, provide some vivid indications of the still tenuous nature of some of these links.

(c) There is a need to bring appropriate persuasion and pressure to bear on governments and telecommunications carriers to expand international data-

network access (and the supporting domestic infrastructure) as a means of improving scientific information exchange with and transfer to developing countries. A failure to take these steps will even further widen the gap between technologically developed and developing countries.

(d) Both the perception and the reality of high cost proved to be something of a barrier to participation in the conference and illustrates the need for the most effective and efficient telecommunications access possible. At the same time, the need for the development of mechanisms that could facilitate low-cost access to such international computer conferences is highlighted (e.g., local/regional nodes that could link into larger international conference activities).

(e) Equipment for accessing the computer conference (i.e., terminals, microcomputers, telecommunications links) needs to be available close at hand if people are to use them readily. It is not just a question of personal convenience, but if use of the computer-conferencing system (and its associated private-messaging facilities) is to become an integral part of the professional life of a scientist (or a scientific group) then the access tools must also be integrated into their regular activity.

(f) Simple, reliable, and low-cost communications software for a wide variety of microcomputer systems should be made available to conference participants to enable them to reduce connect time costs (especially telecommunications costs) and maximize their level of participation. Essential features that must be supported include:

- Terminal emulation (the facility to emulate "dumb" terminals as well as at least a limited range of standard terminal types),
- Redirection of data being transmitted or received to a printer,
- Uploading (transmission from a remote system to a host) and downloading (reception of data from the host to a local system) with at least some error-checking protocol support, and
- Reliable operation at 300 and 1200 baud.

There are a number of communications software packages in the marketplace that could meet these requirements (and more) and selection of one or two of these for use in the context of a specific conference environment would certainly simplify the provision of support to end users.

(g) The essential nature of good technical manuals, training, and ongoing handholding or user assistance is also very clearly indicated as essential to the success of future conference activities. On-the-spot assistance and trouble shooting is most effective, but the same result can be achieved, to some extent, by remotely located "colleague advisers" who are prepared to assist other participants by telephone, telex, electronic message, or post.

(h) Some participants seemed to be relatively easily discouraged and to require considerable positive reinforcement to maintain their status of regular involvement. Some of this discouragement was related to technical aspects of conference participation, such as the case of one questionnaire respondent who reported, "initial transmissions were garbled on my Apple so I terminated." One would hope that his staying power was greater in other fields of scientific endeavour.

Future Technical Possibilities

The technologies used in computer conferencing and related applications are in a constant and rapid state of development and change. The facilities available today far exceed those we would have anticipated even a few years ago and this evolution will no doubt continue in the years ahead. Among trends that are of particular interest in this context one must include:

(a) New and improving access networks and methods. The worldwide web of interconnected digital data networks is expanding and more developing countries are being added constantly. In addition, steps toward the development of a worldwide ISDN (Integrated Services Digital Network) are also continuing even though full realization of such a network is still some time away. Of perhaps more interest to developing countries is some of the work being done in the development of new, low-cost satellite technology for data distribution such as that using spread spectrum transmission techniques. One implementation of this approach, currently in a pilot-project phase, is the IBINET being developed by the Intergovernmental Bureau for Informatics. Other commercial ventures are also emerging.[3] The use of low-cost (high frequency or very high frequency) radio links for "packet radio" systems is being pioneered by many amateur radio operators in Canada and the United States and has considerable potential in many developing countries.

(b) Much more powerful and useful portable computers are appearing on the market with considerable regularity and provide the potential for complete local editing/input stations that are independent of local power supplies (often a source of problems in developing countries) have the facilities to create, edit, and manipulate text and have built-in communications hardware/software. This market has grown rapidly in the past 2 years and will no doubt continue to be one of the most rapidly changing aspects of the microcomputer industry.

(c) International variations in modem standards and requirements haunted a number of participants in this conference (for example, having a terminal with a built in International Telegraph and Telephone Consultative Committee (CCITT) modem when the data port that the participant was trying to use was configured for a Bell 103 standard modem). There is, however, some indication that relief is in sight for this problem with the increased availability of multistandard modems at reasonable prices. As in many other instances, technology is solving the problem with the development of "smart" VLSI (Very Large-Scale Intergration) modem chips that can deal with a number of different transmission standards and signalling requirements. Economical, higher-speed modems (e.g., 2400 baud) are also entering the marketplace and will have a significant impact on North American data-communications activity in the next few years.

(d) It is likely that there will be an increasing trend toward the development of local/regional computer-conferencing systems running on smaller, lower-cost computer systems during the next few years. These will, in turn, be linked into other national and international systems to provide participants with broader access to conferencing activities. Development of the PORTACOM system (based

[3] Hall, Mark. 1984. Satellite links for micros. Micro Communications, 1(7) (August 1984), pp. 40–43.

on the functionality of COM) and the University of Guelph's COSY system (which will run on virtually any UNIX system) are significant indications of movement in this direction.

Conclusion

The technical aspects of computer conferencing will gradually fade into the background and become less of a factor in the effective use of this powerful tool for scientific communications and information exchange. Nonetheless, in the foreseeable future, the role of the communications or technical facilitator will remain an integral part of the successful use of this application of computer, information, and communications technology. Although the technical basis required is gradually becoming simpler and more readily available, without this facilitating support and ongoing assistance , it will be difficult for scientists (or other users) to concentrate on the main object of the exercise, increasing the effective flow of scientific and technical information.

Appendix 1

Summary of Telenet Rates (as of June 1984).

Country	Connect charge	Volume charge	Service
Inbound from foreign locations to Telenet/U.S.			
Alaska[a]	6.50/Hour	7.00/KP	P/L
Argentina	30.00/Hour	1.50/KC	P/L
Australia	12.0/Hour	.60/KC	P/L
Austria	360.0/Hour	8/KC	P/L
Bahamas	12.0/Hour	0.51/KC	P/L
Bahrain	5.70/Hour	.29/KC	P/L
Barbados[a]	$19.80/Hour	$10.90/KC	L
Belgium	360/Hour	250/KS	P/L
Bermuda[a]	10.20/Hour	$0.45/KC	L
Brazil	GF138/Hour	GF 38/KC	P/L
Canada	$2.70/Hour	$1.85/KP	P/L
Chile[a]	$15.00/Hour	$0.65/KC	P/L
Colombia	20.0/Minute	15.0/KC	P
Denmark	75/Hour	3.6/KC	P
Dominican Rep.[a]	10.00/Hour	$0.45/KC	P/L
Finland	108/Hour	2.3/KC	P/L
France	48/Hour	30/KS	P/L
French Antilles	60/Hour	30/KS	P/L
Germany	21/Hour	16/KS	P/L
Hawaii	$2.40/Hour	$3.75/KP	P/L
Hong Kong	60/Hour	3/KC	L
Hungary	360/Hour	8/KC	L
Ireland	7.5/Hour	5/KS	P/L
Israel	128/Hour	$6.40/KS	P/L
Italy	253.10/Minute	145.20/KC	P/L
Japan	2700.00/Hour	120/KC	P/L
Korea	$16/Hour	$0.82/KC	L
Kuwait	5.7/Hour	$0.29/KC	P/L
Luxembourg	480.00/Hour	24/KC	P/L
Mexico[a]	$6.50/Hour	$7.00/KP	P/L
Netherlands	42/Hour	300/KS	P/L
New Zealand	12.00/Hour	.60/KC	P
Norway	72/Hour	3.60/KC	P
Philippines[a]	$12.00/Hour	$0.60/KC	P/L
Portugal	1.2/Hour	35/KC	P
Puerto Rico[a]	$5.00/Hour	$4.00/KP	P/L
Qatar	5.7/Hour	0.29/KC	P/L
Saudia Arabia	5.7/Hour	0.29/KC	P/L
Singapore	50/Hour	240.0/KS	P/L
South Africa	0.29/Min	12/KS	P/L
Spain	1000/Hour	50/KC	P/L
Sweden	120/Hour	60/KS	P/L
Switzerland	15/Hour	15/KS	P/L
Taiwan	480/Hour	24/KC	L
Thailand[a]	$12.00/Hour	$0.60/KC	P
UAE	60/Hour	2.5/KC	P/L
United Kingdom	4.80/Hour	3/KS	P/L
Virgin Islands[a]	$10.00/Hour	$0.45/KC	P/L
Outbound calls from Telenet/U.S. to foreign locations			
Alaska	6.50/Hour	7.00/KP	P/L
Australia	12.00/Hour	16.00/KS	P/L
Belgium	10.00/Hour	12.00/KS	P/L
Brazil	12.00/Hour	16.00/KS	P/L

(continued)

Appendix 1. Concluded.

Country	Connect charge	Volume charge	Service
Canada	4.50/Hour	4.20/KP	P/L
Chile	12.00/Hour	12.00/KS	P/L
Dominican Rep.	8.00/Hour	8.00/KS	P/L
France	10.00/Hour	12.00/KS	P/L
Gabon	12.00/Hour	16.00//KS	P/L
Greece	10.00/Hour	12.00/KS	P/L
Hawaii	6.50/Hour	3.75/KP	P/L
Ireland	10.00/Hour	12.00/KS	P/L
Israel	12.00/Hour	16.00/KS	P/L
Japan	12.00/Hour	16.00/KS	P/L
Luxembourg	10.00/Hour	12.00/KS	P/L
Mexico	6.50/Hour	7.00/KP	P/L
Netherlands	10.00/Hour	12.00/KS	P/L
Puerto Rico	5.00/Hour	4.00/KP	P/L
Singapore	12.00/Hour	16.00/KS	P/L
South Africa	12.00/Hour	16.00/KS	P/L
Sweden	10.00/Hour	12.00/KS	P/L
Switzerland	10.00/Hour	12.00/KS	P/L
United Kingdom	10.00/Hour	12.00/KS	P/L

Note: For inbound calls, a superscript "a" indicates charges are in U.S. dollars; all other charges are in local currency. All outbound calls charged in U.S. dollars. P = Public Dial-In Service, L = Leased Line Service, KP = Kilopacket, KS = Kilosegment, and KC = Kilocharacter.

Appendix 2

Examples of Telenet International Access Arrangements
(in place as of June 1984).

ARGENTINA

ARGENTINA TO TELENET/U.S.:
Public Dial-In Service at 110–300 bps
Leased Line Service at 110–300 bps

RATES:

Subscription Charge:	None
Connection Charge:	30 Gold Francs/Hour
Traffic Charge:	1.50 Gold Francs/Kilocharacter
Minimum Charge:	30 Gold Francs
Telephone Access Charge:	None

GATEWAY LOCATION:
Buenos Aires

BAHRAIN

BAHRAIN TO TELENET/U.S.:
Public Dial-In Service at 110–300 bps, 1200 bps
Leased Line Service available

RATES:

Subscription Charge:	25 Dinar/Month
Connection Charge:	5.7 D/Hour
Traffic Charge:	.29 D/Kilocharacter
Minimum Charge:	1.4 D/Session
Telephone Access Charge:	.26 D/Connection

GATEWAY LOCATION:
Hong Kong, New York

(continued)

BRAZIL/INTERDATA

BRAZIL TO TELENET/U.S.:
Public Dial-In Service at 300 bps
Telex Access at 50 bps (dial in service)
Leased Line Service up to 1200 bps

RATES:

Subscription Charge:	180.00 Gold Francs (one time fee)
Traffic Charge:	3.80 Gold Francs/Kilocharacter
Connection Charge:	
Public Dial Service:	138.00 Gold Francs/Hour
Telex Access:	54.00 Gold Francs/Hour
Minimum Charge:	for dedicated service only
Taxes:	5% surcharge on all charges

GATEWAY LOCATION:
Rio de Janiero

HONG KONG/IDAS

International Database Access Service

HONG KONG TO TELENET/U.S.:
Leased Line Service at 110–300 bps and 1200 bps

RATES:

Subscription Charge:	300.00 HK/Month for 300 bps
	450.00 HK/Month for 1200 bps
Line Charge:	148.00/Month
Modem Charge:	155.00 HK/Month (110–300 bps)
	355.00 HK/Month (1200 bps)
Connection Charge:	60.00 HK/Hour
Traffic Charge:	100.00 HK/Hour
Minimum Charge:	2.00 HK/connection + 10 segments
Telephone Access Charge:	None
Installation Charge:	580.00 HK one time for line
	200.00 HK one time for modem

GATEWAY LOCATION:
Hong Kong

ITALY

ITALY TO TELENET/U.S.:
Public Dial-In Service at 110–300 bps
Leased Line Service available up to 1200 bps

RATES:

Subscription Charge:	10000 L Monthly per user name
Connection Charge:	277.60 L/Minute
Traffic Charge:	160.00 L/Kilocharacter
Minimum Charge:	1 Minute/Kilocharacter
Telephone Access Charge:	Varies with distance
Data Transmission	
Government Tax Charge:	10000 L Monthly
Modem Rental (300 bps): (if required)	22835 L Monthly

GATEWAY LOCATION:
Rome, Milan

(continued)

IVORY COAST

IVORY COAST TO TELENET/U.S.:
Public Dial-In Service up to 4800 bps
X.25 Leased Lines up to 4800 bps

RATES:

Subscription Charge:	None
Connection Charge:	82.0 F/Hour
Traffic Charge:	62.0 F/Kilosegment
Minimum Charge:	10 Segments

GATEWAY LOCATION:
Paris, France

JAPAN/Venus-P

JAPAN TO TELENET/U.S.:
Public Dial-In Service up to 1200 bps
Leased Line Service up to 9600 bps

RATES:

Subscription Charge:	300 Y/Account
Connection Charge:	2700 Y/Hour
Traffic Charge:	3000 Y/Kilosegment
Minimum Charge:	None

GATEWAY LOCATION:
Tokyo, Osaka

CARRIER:
ITT, RCA, WUI

Protocols for Leased Line Service:
X.25 (LAP-8)
HDLC (ISO)
BSC (IBM 2780/3780)

Rates for Leased Line Service:

Installation Charge:	80000 Y one time for 300 bps
	110000 Y one time for 1200 bps to 9600 bps
For 300 bps:	21400 Y/Month
For 1200 bps:	28200 Y/Month
For 2400 bps:	48000 Y/Month
For 4800 bps:	75000 Y/Month
For 9600 bps:	114000 Y/Month

SINGAPORE

SINGAPORE TO TELENET/U.S.:
Public Dial-In Service up to 1200 bps
Leased Line Service up to 1200 bps

RATES:
Public Dial Service:

Subscription Charge:	50.0 SGB/Month per ID
Connection Charge:	30.0 SGB/Hour
Traffic Charge:	24.0 SGB/Kilosegment
Minimum Charge:	10.0 SGB
Telephone Access:	75.0 SGB/Quarter
Modem Charge:	50.0 SGB/Month
License Fee:	10.0 SGB/Month
Installation (one time):	100.0 SGB for Modem
	50.0 SGB for Telephone

(continued)

Leased Line Service:

Subscription Charge:	150.0 SGB/Month
Modem Charge:	35.0 SGB/Month
License Fee:	10.0 SGB/Month
Leased Line:	107.0 SGB/Month
Installation (one time):	100.0 SGB for Line
	100.0 SGB for Modem

GATEWAY LOCATION:
Singapore

THAILAND

THAILAND TO TELENET/U.S.:
Public Dial-In Service up to 1200 bps

RATES:

Connection Charge:	US$12.00/Hour
Traffic Charge:	US$0.60/Kilocharacter

Appendix 3

Systems Access Costs

It is difficult and inappropriate to attempt a direct cost comparison of the use of the two computer-conferencing host systems involved in the bioconversion of lignocellulosics computer conference because the charging philosophies are dramatically different and could only be compared by a detailed examination of individual use patterns. An outline of the basic charging methodologies of the two systems will, however, give some indication of the order of the costs involved.

The usual EIES charges are based on a flat fee of US$75.00 (regardless of the amount of usage) per month for each user id plus telecommunications costs. This includes a data-storage allowance of US$30.00/month (more than sufficient for most users). In addition, EIES offers "group accounts" at US$200.00/month for the basic account (including one full "class 1" user account) plus US$10.00/month for each additional user id and then US$8.00/hour for use of the system. For this conference, special arrangements were also made for participants to have "class 2" accounts on the basis of US$ 8.00/hour for use of the system with a US$25.00 monthly use minimum (class 2 users were subject to a lower priority for access at certain times of day and did not have access to private storage facilities).

In addition to these costs, users must also cover the necessary telecommunications costs to reach EIES. For North American users, the packet-switched network access is on a "collect call" basis with EIES billing the costs back to users at the following hourly rates: US$7.00 for Uninet, US$9.00 prime time via Telenet, US$6.00 weekends and 2400 to 0600 hours via Telenet, US$10.50 Canada and Hawaii, and US$18.00 Alaska. "Off-shore" users must pay their telecommunications costs at the rates indicated in Appendix 1.

Typical basic costs for a "university user" (subject to a multiplier for other classes of users) are given in a COM paper by Jacob Palme "COM Usage Costs" dated 1983-12-31. Expressed in Swedish Kroner (SEK) these are: fixed fee per month, 12.20; entering COM and exiting directly, 6.40; reading a COM entry of 6 lines, 0.95; writing a COM entry of 6 lines, 5.74; reading a COM entry of 100 lines, 2.51; and writing a COM entry of 100 lines, 10.60.

In the same paper the cost of gaining access to COM from outside Sweden is estimated as being 40 SEK/hour from other Scandinavian countries, 80 SEK/hour from other European countries, and 160 SEK/hour from North America.

The COM charging methodology is more complex than that used by EIES and includes a number of components plus a differential for various types of users as well as the time of day/day of the week when the system is used. Assuming the "university rate" as a basis, other "public research organizations" pay 1.6 times this rate and "other" users 2.2 times the university rate. COM usage charges are based on office hours (0700–1700 weekdays) as 1, 1700–2000 multiplied by a factor of 0.6, 2000–0700 plus all day Saturday and all day Sunday are multiplied by 0.3.

Appendix 4

Examples of Local Site Equipment Costs[1]

Prices of microcomputers, terminals, and modems are changing constantly, therefore, making it very difficult to give any firm cost estimates that will apply at any particular point in the future. The following examples are based on U.S. price levels in early 1984, and by the time such equipment is in place in other countries the cost may well be two or three times the levels indicated here.

Three levels of configurations are indicated:

- "Dumb" video display Terminal and Modem: terminal, US$600; modem (300 baud), US$150; and (optional printer), US$750.
- "Dumb" printing terminal: Terminal, US$1000 and Modem (300 baud), US$150.
- Basic microcomputer system: two disk drives, display, communications software, US$2000; Modem (300 baud), US$150; Modem (1200 baud), US$700; and Printer, US$750.

[1]The information found in Appendices 1 through 4 is provided for illustrative purposes only; its accuracy cannot be guaranteed.

A Viewpoint from a Developing Country

Rocio Marban and Carlos Rolz[1]

The System of Computer Conferencing

When the International Development Research Centre (IDRC) contacted the Central American Research Institute for Industry (ICAITI) for participation in the computer conference on bioconversion of lignocellulosics, it seemed that communications problems — if any — might be solved easily. Several years ago we had decided to access computerized data bases and, after a few trials through Telex, we had bought an acoustic coupler terminal. When we ordered it we had to specify if we wanted a Bell-compatible or an International Telegraph and Telephone Consultative Committee (CCITT) acoustic coupler; we asked the local phone company and were told that CCITT is the standard in use locally. Our terminal, a Texas Instruments TI-745, works very well when calling the international access numbers of major data base services such as Dialog and Orbit in the U.S.

At the time of this conference we were already considering using the microcomputers available to us for data transmission and we had ordered the necessary modems. We want to use a microcomputer not only to send and receive data through screen or printer or both but also to store on diskette data to be sent and data as received. We believed that communication through the microcomputer modems would be as straightforward as what we had been doing already in accessing data bases.

Our first attempts at accessing the conference were done using our acoustic coupler terminal. Following the instructions for access sent by the Electronic Information Exchange System (EIES), we dialed Telenet, trying several different nodes in different states of the U.S. (there are no packet-switched nodes in Guatemala). We would get a carrier tone but no response from the system. Calls to Uninet and direct-dial to the EIES computer gave the same result. We checked doing searches to Dialog, using the same telephone line and the same terminal, with satisfactory results.

What we did not know then is that, although the United States, Canada, and Mexico operate with modems governed by the Bell standard, the rest of the world uses CCITT standards. "For example a 300-baud modem based on Bell 103 standard calls for sending and receiving data on frequencies of 1070, 1270, 2025 and 2225 cycles per second. But the CCITT V.21 - standard modems . . . . although they also run at 300 baud, expect to send and receive only at frequencies

[1] Head, Documentation and Information Division and Head, Applied Research Division, Central American Research Institute for Industry (ICAITI), P.O. Box 1552, Guatemala City, Guatemala, C.A., respectively.

of 980, 1180, 1650 and 1850 cycles per second . . . . the frequencies don't match up."[2] We had been able to access Dialog and Orbit because these systems have the capacity of specifically receiving signals from CCITT standard equipment.

In retrospect, this seems fairly obvious and a point that should have been easily clarified by a "simple call to the local telephone company." There is no such thing as a simple call when you do not know exactly what to ask and are exploring a field relatively new to you.

We also tried access with our microcomputers, with two different modems and different communications software packages. We ran against new problems. First, a cable had to be modified, then we needed a connector not available locally, the communications card had to be sent back to the U.S. dealer for replacement; this can take quite a while when there are no local suppliers and there are stringent currency restrictions.

Meanwhile, we read about echo suppressors, satellites and microwaves, leased lines; we tried via Mexico; we talked to several people at the telephone company; we tried to obtain trial access through dedicated lines as a check on our equipment.

At long last, using an Apple II + microcomputer with a Bell 103 compatible modem, we were able to establish connection and to start direct participation in the conference. There were still some problems. We lost characters at the start of the lines and we were unable to capture data on diskettes. Our priority by then was decidedly on the technical aspects of the conference and we did not spend more time (and money) to solve these problems.

Because there are no packet-switched nodes presently established in Guatemala, calls are long-distance direct-dial on regular voice channels and the cost is tremendously high. We are speaking of US$2.00 for each minute or less, and this includes aborted calls. It is very easy to run up an impressively high telephone bill while experimenting or when information is requested on-line at 300 baud.

In our case there were no legal restrictions but this is another point that should be checked on. "The 2025 and 2225 cycles per second frequencies of a 300 baud U.S. modem fall into the 'forbidden band' reserved by the CCITT for telephone company signalling. If the local . . . phone company happens not to use that band, there will be no problem. But if it does, the modem may simply not work or it may cause all sorts of bizarre or erratic behavior — such as fouling up the billing or causing the telephone to hang up" (McKean 1984, op. cit.). That is probably why, in some countries, use of modems is prohibited or restricted.

We have gone into some detail to show possible pitfalls and delays that may beset participants from developing countries. In spite of these difficulties, we believe that computer conferencing does make sense, even more so with current travel costs and foreign currencies scarcity and restrictions. The telephone company is actually talking about packet-switching that should lower the cost of communication to a point where it becomes acceptable. No doubt, more and more countries will make it easier and cheaper to transmit data by computer. As

[2] McKean, Kevin. 1984. When you compute outside the U.S. Personal Computing, 8(9), 147–149, 151–153.

more people use these systems and more is written and becomes known about them, it will be easier to select appropriate equipment and to know what information to seek to avoid wasting time and money. Hopefully too, local telephone organizations will work according to standards of more international application.

Subject of the Conference: Bioconversion of Lignocellulosics

From the point of view of the technical content of the subject, we would like to say a few words regarding what aspects we found useful and what others we found not useful, then we would like to comment in a general form about the technical participation in the conference by scientists from industrialized and developing countries and, finally, what we believe are the advantages of employing such a system in discussing a technical subject.

We received printouts by ordinary mail directly from IDRC during most of the conference and it was not until the end that we were able to connect and receive information on-line. Unfortunately, we were flooded by it and it was practically impossible to study it or to initiate any kind of sustained interlocution with one or several participants. Hence, we must say frankly that we did not experience the true advantages of computer conferencing. Nevertheless we found useful the following:

(a) Updating our knowledge on current research activities by people around the world. The comments made by them influenced our own, ongoing research projects and, hence, we believe, in some cases, saved us valuable time. Although no detailed research results were given, like in a technical publication, the comments were useful in transferring very quickly conceptual matters, new ideas or approaches, basic methodology, and criticism of currently used techniques.

(b) We found out about research activities in laboratories new to us. This was an excellent reward. We were able to include on a previously planned trip a visit to some of these. Computer conferencing here is invaluable and hard to beat, as we became aware of research activities of great interest that were not previously available to us, either through simple ignorance or because we could not afford and did not receive in our library the adequate journals or because we did not understand the language of the publications.

(c) As scientists in developing countries we sometimes wonder if our research ideas might be way off track. It was comforting in this sense to have read that others were thinking along the same lines (or were not, which made us a little more nervous). One must remember that in developing countries we have very few chances to meet with fellow workers and test our ideas. Computer conferencing here will be of great value to the isolated researcher.

(d) Some thorough discussions on specific subjects were started by various individuals mainly in the last month of the conference. We found them extremely interesting and useful. Especially useful were those dealing with enzymatic analysis, solid substrate growth, enzyme adsorption, isoenzymes and their control, anaerobic hydrolysis, and substrate pretreatments. However, we were disappointed that the conference ended at the moment when things were beginning to make sense.

From the point of view of participation, we were very much impressed by the open and frank way that different scientists presented their views and were eager to discuss their results. This clearly showed that cooperation indeed is part of the scientist's gene pool and what it needs is the proper channel to proceed.

The participation of scientists from developing countries was low indeed. However, those that participated, we believed, contributed very nicely in presenting their points of view and priorities. There is still the feeling that "my research might not be at all relevant" or "is not up-to-date" among scientists from more developed countries and this fact might explain why we did not participate more actively. Computer conferencing is indeed a powerful technique to overcome that attitude and induce in the young scientist the more positive stance of pursuing creativeness and being ready to explain and defend new ideas to a large group of fellow workers.

As it always happens, there were contributions of a patronizing nature: telling developing countries how to proceed and what is important and what is not. For example, a few people during the length of the conference made the remark that instead of discussing the current topics in question they should address those that were more relevant to developing countries. We wonder who told them that they were not important to developing countries. On the contrary, we found them very relevant. What we did not like was that there were few participants from developing countries discussing these subjects. It is extremely important for developing-country scientists to know what is the current state of the art and the advanced research areas in the bioconversion of lignocellulosics. This is a crucial issue and should be emphasized strongly.

As a conclusion we would like to say that we as scientists see a very bright future for computer conferencing. We see it as an excellent way of communicating ideas and exchanging know-how. We see it as the only tool whereby the scientist-to-scientist contact is stimulated. However, we foresee some dark clouds. We believe that international organizations might not like the idea very much. In principle, computer conferencing makes unnecessary and obsolete the technical bureaucracy solely devoted to assisting developing countries. This fact might create, if it has not done so already, a powerful attitude of resistance. We also believe that many are worried that if used correctly this technique could lead to a large know-how and technology leak. To some groups this might be unthinkable. We only hope that we are totally wrong. Time will tell and one initial sign of the future trend will be if there is a continuation of this excellent computer conference on bioconversion of lignocellulosics.

If I Had My Druthers[1]

R. P. Overend[2]

With 20:20 hindsight the bioconversion of lignocellulosics computer conference can only be described as an ambitious pioneering effort that achieved many of its goals with respect to the industrialized-country participants and rather few of them for the developing-country participants. I would like to offer a perspective and recommendations on the procedures and technological features that might facilitate future collaborations. Although I have had many discussions with colleagues on this matter, I must state at the outset that what I will discuss is indeed a personal view not only of what transpired but also of possible remedies.

In the technocrat's world there is frequently jargon that serves to confuse those not in the circle. One ironic term used by computerniks is that such and such a procedure or feature is "transparent" to a user. By transparent the computernik is implying that the particular feature is not in fact seen by a user but is utilized nevertheless. From the outset of this conference in 1983 it had to be recognized that very little of the technology was indeed transparent, in fact many of us learned far more about bits, bytes, and modems than one could reasonably have anticipated. Another jargon term is "user friendly," which the majority of terminal software and EIES/COM menus are most definitely not. Thus, I would postulate that because the systems and software were neither transparent nor user friendly the technology of computer conferencing was in fact a barrier to many of the actual and potential users.

The Technology Factor

It was no surprise that many of the North American participants took time to get onto the system. Even connecting up a modem to the personal computer (PC) was as fraught with difficulty as was initiating the contact with Electronic Information Exchange System (EIES). In my own case, the modem that I initially borrowed did not perform when connected to my PC. The reason was that the RS-232C connecting cable had been wired to connect to a video display terminal (VDT), thus it was that both the modem and VDT were assumed to be DCEs (DCE = Data Communication Equipment). My personal computer RS-232C port was, however, wired as a DTE (DTE = Data Terminal Equipment). The resulting noncommunication was resolved when I reversed pins 2 and 3 in the modem cable. The moral is, of course, that nothing is standard in the computer business.

[1] "Druthers" is a dialect word used in the context of "if I had a choice."

[2]National Research Council of Canada, Montreal Road, Ottawa, Ontario, Canada K1A 0R6.

Even when connected, the problems did not cease; the intricacies of number of bits, parity, baud rates, duplex or half duplex are all settings required in the software even before you can get Datapac (a Canadian packet-switched network) to respond!

Recommendation 1

More technical support for first-time computer-conferencing users should be given. In particular, it would be useful for the sponsors to recommend equipment choices to those just getting into the game. For the developing-country participants, the problems of technical support are infinitely greater than those for industrialized-country participants. I would recommend that the aid agencies purchase the appropriate equipment combination and supply this as well as technician support to at least have some operating systems in developing country centres. Standardization at this stage of computer development on a 16-bit machine, one brand of modem for each of the two systems, i.e., Electronic Industries Association (EIA) RS232C and CCITT V.24 along with appropriate software, would help.

Operating Experience

Even once the equipment works and communication is established it is evident that there is not necessarily any flow of intelligence. In particular, the medium is unusual and unless the user is prepared to spend some time at the terminal the real benefits will not emerge. With a PC/modem combination, all users can access information services such as the Canadian on-Line Enquiry Service (CAN/OLE) or Lockheed Dialog services. For the developing-country participant, access to such a service would be invaluable for the scientific researcher. A second advantage for the aid sponsor and recipient would be the use of such systems for project management. The final benefit would be in what we have called computer conferencing.

One of the problems, therefore, was that this conference started with the most difficult and challenging applications of terminal technology. In my own case, the evolution of skills proceeded from data base searching in a library to participation in project management and then onto computer conferencing. The most useful feature of the conferencing system initially is the electronic mail facility in project management, experience with this eventually leads to computer conferencing.

Recommendation 2

Prior to another attempt at an international computer conference such as this one, there should be a program of technology implementation targeted at getting the scientists concerned to use all of the potential benefits of the medium in terms of information retrieval and project/program management as well as computer conferencing.

Management of the Conference

At this stage of computer conferencing, it would be much better if the various moderators of the conference activity were both fluent in the management of the

medium and of conferences. In general, we were successful in the latter but not in the former. One suggestion would be that the group of moderators should be in place at least 3 months before the start of the public participation and should, during that time, use computer conferencing as a planning and management tool. For example, it would have been useful to have had a system of rigorous referencing and selection of topics to steer the participants. This suggests, as with structured workshops, that the moderator has to provide a strong initial direction.

Recommendation 3

The management group, i.e., moderators, should assume their positions before the public opening of the conference and establish fluency in operating their own systems and the conference.

Conclusions

To misquote McLuhan, the medium is not the message. In future computer conferencing it will be of paramount importance to establish a reliable electronic link before initiating the information exchange and dialogue that we hope will constitute the scientific component of the activity. The bioconversion of lignocellulosics computer-conference experience was exciting but barely scratched the surface of the potential benefits of computer conferencing. To ensure a more effective conference, the hardware and computer software have to become both more transparent and user friendly to be truly useful.

About the Author

R.P. Overend has had a long and interesting battle with technologies. His first exposure to computer technology was in the relatively early days in 1960 when strange languages such as ALGOL were in vogue being run on computers with todays PC characteristics but with price tags in the millions of dollars and requiring not only large specially air-conditioned buildings but also a high priesthood to operate them. Described by some of his friends as a technocrat, less loving ones have called him a technojunkie. His qualifications to participate in the computer conference and to offer these views are a PhD in Physical Chemistry, a community college electronics qualification as well as holding the radio amateur call VE3-GYK. These may explain why it only took him 3 days to work out the pin 2 and 3 switch! His first experience with computer conferencing was gained in the COM system in the closed conference IEABLTF, which was used to both manage and integrate study activities in biomass liquefaction being carried out in the USA, Canada, Sweden, and Finland.

,

Future Directions

D. G. Howell[1]

The study now reported relates to the use of computerized conferencing as a means of rapid and spontaneous communication between scientists and, although the procedures followed were very much of a pioneering nature, a great deal of interest was provoked. Indeed, during the course of the conference a considerable number of inquiries were received as to its use and application. The subject area selected is highly topical in relation to biotechnological research in both industrialized and developing countries and resulted in active participation across a wide front. Unfortunately, most participants were from the industrialized countries and developing-country participation was minimal. Here then lies a problem and a challenge because it is probably correct to assert that computerized conferencing offers a greater opportunity for meaningful interaction with developing-country scientists than with their more fortunate colleagues.

In a field such as biotechnology where new discovery and advance take place daily, the traditional methods of communication may well become obsolete and in this is included conferences and workshops and even the traditional method of communication, namely the refereed journals. These will continue to play an appropriate and complementary role but the dynamics of the situation require the ability to communicate rapidly and the establishment of networks between scientists and laboratories working in similar areas of endeavour at both the national and international levels.

Digital methods of communication will undoubtedly grow and expand in the industrialized north and will, within a very short time-frame, reach a high level of sophistication. This will come about as a result of entrepreneurial activity from the private sector and from computer science departments at universities working in conjunction with the private sector, and little effort is needed because its progress is inevitable. However, it is in relation to developing countries that attention will have to be paid by agencies at both national and international levels.

It is, thus, a matter of considerable satisfaction to note that the International Development Research Centre (IDRC) has for some time seen the necessity for this and has been planning accordingly. The workshop held by the IDRC in 1981 entitled "Computer-Based Conferencing Systems for Developing Countries"[2] resulted in the publication of an excellent report on the subject and clearly opened the door to its wider consideration. Other notable bodies such as the World Academy of Art and Science (WAAS) and the International Federation of Institutes

[1] Centre for International Programs, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

[2] Balson, D., Drysdale, R., and Stanley, B. ed. 1981. Computer-based conferencing systems for developing countries. Report of a workshop held in Ottawa, Canada, 26–30 October 1981. International Development Research Centre (IDRC), Ottawa, Canada, IDRC-190e, 43 p.

for Advanced Study (IFIAS) are also charged with the wisdom of developments of this kind and have been most active in promoting the concept.

In recent months, the United Nations Industrial Development Organization (UNIDO) has been promoting the idea of an international centre for biotechnology. The original concept was for a fairly sophisticated central institute, but discussions surrounding it now point to an international networking system embracing national and regional laboratories. For this to succeed, however, the inception of an efficient means of rapid communication is required and in a number of associated discussions computer conferencing is recognized as central to a resolution of the problem.

In viewing the problems of the developing world, the introduction and availability of biotechnology may offer a key to the resolution of a number of their problems that reside principally in the food, energy, and health fields. If biotechnological advances are not applied to the needs of developing countries then the gap between the "rich north" and the "poor south" will widen instead of being narrowed. The need to train scientists from developing countries in biotechnology and in particular to its application must be a priority matter. However, all this will be severely vitiated if the means is not established whereby these scientists are kept up-to-date following their return from training abroad. A means for rapid, constant, and inexpensive communication is thus vital. Computer conferencing offers a solution, if not in its entirety, one that will fill a real and significant gap.

In the field of biotechnology and applied microbiology the need to establish an international network of laboratories and resources was recognized some years ago by the United Nations Educational, Scientific and Cultural Organization (Unesco), the United Nations Environmental Program (UNEP), and the International Cell Research Organization (ICRO). A comprehensive network has been progressively established and at this time some 15 institutions in both industrialized and developing countries are participating. The ICRO Panel for Applied Microbiology and Biotechnology is actively promoting and expanding the concept. The individual components of the network are described as Microbiological Resource Centers (MIRCEN). Although the individual MIRCEN concentrate on a particular aspect of applied microbiology and biotechnology, the common theme is identified with technology transfer for Third World development and is carried out by training courses, workshops, newsletters, etc.

There is no doubt that this high purpose would be considerably facilitated if day-to-day interactions could occur, particularly between scientists working within the network. Computer conferencing would undoubtedly be a considerable asset and the appropriate equipment could also be used for other purposes, such as literature searches, word processing, and data storage.

It appears that computer conferencing can be a very important tool in technology transfer, particularly to developing countries — and it behooves those at the policy- and decisionmaking levels to identify how best this can be implemented. The extent to which this kind of thing should be handled through the international agencies is questionable, because so often procedural difficulties and interagency protocol militate against innovative activity. The inception of a program designed to establish really what is required probably resides more readily through a nongovernmental organization (NGO) and appropriate institutional cooperative programs.

Carl-Goran Hedén of the Karolinska Institutet, Stockholm, Sweden, has unquestionably been in the forefront of promoting concepts of this kind. In a most informative presentation to the Canadian Association for Information Science he indicated how his interest in this topic has developed with increasing tempo in recent years. Indeed he sees the ramifications of computer conferencing extending into a wide horizon, and wrote as follows:

> As important as such activities might hopefully become in the context of international cooperation in applied microbiology and biotechnology for the benefit of developing countries, their main contribution might well prove to be in the political arena.
>
> Just as the development of civilization has largely developed on the existence of a symbiotic relationship between research and the communication of research results, there is probably a similar relation which determines the building of trust between nations. I am thinking of the relationship between constructive political moves on the one hand and the communication of their true meaning on the other.
>
> From this point of view, a broadening of the free communication among scientists, from both East and West, may help to prevent some of their leaders from behaving 'as if their brains had been amputated' (C.P. Snow).
>
> As illustrated by the recent video conference between Washington and Moscow, scientists don't seem to have any problem agreeing even on such a knotty problem as the impact of nuclear war on the atmosphere and on the biosphere.
>
> I permit myself to end this talk by expressing the hope that the active East-West dialogue, which was such a striking feature of the bioconversion exercise, might be a tiny step towards building the trust between nations without which I feel that mankind is doomed. One day computer conferencing may perhaps even enter the area of international bargaining, negotiations, conflict resolution and crisis management.

If activity of this kind is indeed to be established as a result of initiatives in the industrialized world, a commitment from developing countries is, of course, also essential. A commitment to develop services of the kind required to support computer conferencing is necessary and the forward programs of post and telegraph services in developing countries must assume this responsibility. It must be remembered that computer conferencing is not simply a means for sending messages, but should be viewed as an active data base and as a principle means of technology transfer.

The conference now being reported upon confirmed the value of computer conferencing and will undoubtedly encourage those concerned to extend and develop it. The provision of the essential hardware, particularly to the centres in the developing countries, and education in its use and adaptation to particular needs, will undoubtedly be required. The costs of doing this are relatively small, and it will take time for full realization, but, meanwhile, further conferences should be encouraged and planned so that problems can be fully addressed. These could take place in association with conventional international conferences such as the Global Impacts of Applied Microbiology Conference (GIAM) to be held in Helsinki in 1985, as well as on a more local and regional basis. A matter to which early attention should be paid concerns the system to be employed. A number are available and could be used. A study on which of these is likely to be the

most appropriate for the purpose required could usefully be carried out. Cost is, of course, an important matter and the availability of a system that can be used on a global basis is clearly most important.

Development of the kind proposed will harmonize with the often stated objective of contemporary aid programs, namely to promote indigenous capability. The greatest challenge we have is to keep young scientists in developing countries current in their field of scholarship and to avoid the frustration that so many of them acquire, particularly after having spent 3–4 years in overseas study.

In summary, computer conferencing could readily be the key to a resolution of a long-standing problem, namely technology transfer to developing countries. A bold, imaginative plan sponsored by an industrialized country, operating possibly with an appropriate NGO, might be the route to follow and the one most likely to succeed. The matter should be given high priority consideration because relative to the potential benefits, the costs are small.

Conclusions

D.A. Balson[1]

The computer conference on bioconversion of lignocellulosics had two stated objectives: on the scientific level, to explore the application of the bioconversion of lignocellulosics for development purposes; and on the technical/communication level, to explore the appropriateness of using computer conferencing to facilitate scientific discussions. Were these objectives realized?

There are no clear-cut answers to this question. As far as the scientific content is concerned, participants from industrialized countries were generally less pleased with the scientific discussions and the amount of new information presented than with the technology itself. In this experiment, there seemed to be too many subject themes in the one conference. Because of concerns on whether entries in the conference would be considered "published" or not, participants were inhibited about sharing new research data or findings. Some participants found it difficult to judge the quality of comments without built-in checking procedures.

On the other hand, although the sample size was low, researchers in developing countries found the scientific content very valuable for the following reasons: updating of current research activities in other countries, discovery of research activities taking place in laboratories previously unknown to them, confirmation of the appropriateness of their research ideas (or the converse), and exposure to particular scientifc discussions among peers throughout the world.

Certain conclusions can be drawn. To improve the scientific content for industrialized-country researchers, the structure of the conference and the role of the moderator(s) may be critical to success. Because conferencing seems to be most effective for groups with a specific task, separate conferences should be set up for each major topic. This especially applies for discussions among the participants of a nonscientific nature. If separate topics are not relegated to their own conference, the conferencing system should be structured to allow automated ordering of related entries. Any excessively long entries, which may or may not be of interest to all, should be separated from the main discussions with an access facility available for only those individuals interested in reading them.

The thorny question of what constitutes "publication" with respect to computer conferencing will need to be answered satisfactorily before one can be assured that researchers will share new information where patent or "publish or perish" concerns exist. Related to this question, the decision on whether to run an "open" or "closed" conference may have some impact on the participants' contributions. To ensure better checks on the quality of information entered,

[1] Information Sciences Division, International Development Research Centre (IDRC), P.O. Box 8500, Ottawa, Ontario, Canada K1G 3H9.

recognized experts in the field being discussed should be encouraged to participate actively.

With respect to the second objective, the viability of computer conferencing, there was more agreement. In general, the technique of computer conferencing was accepted as a viable medium for facilitating scientifc research. Of those particpants who responded to the questionnaire, only 6% would not participate again in a computer conference on a subject of interest to them, 75% of the industrialized-country participants would participate, all of the developing-country respondents would participate, and the remainder were undecided. Along with the advantages gained from having a written record, the inherent characteristics of computer conferencing because of its asynchronous nature (participation at a time and rate of one's own choice, being able to be close to one's data sources, and being able to contemplate answers to questions before responding) were cited as the most important benefits.

For the developing-country participants, the greatest impediments to participation were related to access to terminals, reliable telecommunication links, access to the international data transmission networks, and the costs of participating. For the most part, participants from industrialized countries valued the exercise more for the experience in using computer conferencing rather than for the scientific discussions themselves. For them, drawbacks to this computer conference were predominately information related: too many repetitious comments, unwillingness of other participants to share new information, and lack of responses to their contributions. Nonparticipants did not participate because of cost, lack of access to a terminal, lack of access to international data transmission networks, time constraints, or all of the above.

Perhaps the most valuable outcome of this activity has been the lessons learned concerning the use of computer conferencing. It seems apparent that this technique of communicating is best suited for dispersed groups working toward common goals with a need for regular communication. Convenient access to terminals and the existence of reliable telecommunication links is of course essential. To ensure greater participation of researchers in developing countries, improvement of the local telecommunications infrastructure and the encouragement of the expansion of the international data-transmission networks will be necessary. In the interim, the use of telex interfaces, with careful use of keywords and length of text indicators, along with regular mailings of the proceedings, may allow greater participation geographically. Furthermore, the use of regular mail and face-to-face meetings in concert with a computer conference should enhance the discussions and expand the potential user group. With respect to complementary face-to-face meetings (like the dispersed workshop phase in this exercise), it might be advantageous to hold them early in a conference to allow some personal contact and to stimulate the discussions.

It is important to employ reliable, easy-to-use, conferencing systems that have good editing software and linkages to other conferencing/messaging systems. To minimize communication costs, it is advisable to be able to upload entries easily, after local input and editing on a microcomputer or word processor, and to download the conference contents for reading at one's convenience. The system need not be complicated as most users use only the basic facilities. As stated earlier, the system should be structured to allow easy tracking of content

threads. Clear, concise system documentation must be available as well as resource persons for training and troubleshooting, whether on-line or through more conventional channels. This troubleshooting or "hand-holding" function should be available on an ongoing basis. In addition, if participants are not "computer-wise" and do not have ready access to expertise, technical support should be made available by the conference organization.

The planning, organization, and operation of a conference such as this one is not a trivial job. A great deal of time and effort must be expended. If the participants are novices, a considerable amount of time will pass before they will be able to participate operationally. It is essential to have strong and effective leadership. Moderators should be recognized experts in the subject area and have the time and support necessary to carry out the demanding tasks required by the role. To encourage contributions by participants, "rewards" should be provided by experts' recognition of valuable contributions and through the publication, in hardcopy form, of the conference proceedings.

One of the most worthwhile elements of a face-to-face conference is the corridor chatter that takes place. Similarly, private messaging among conference participants can be extremely useful. This computer conference may have been viewed more formally than intended, thus limiting the use of the private messaging facility. Its use should be encouraged. From the organizers' point of view, the messaging facility is very effective for facilitating planning before, during, and after the event.

Although the computer conference on bioconversion of lignocellulosics was not a complete success, it did open a window on a new technology for a large group within the biotechnology community. Definitely there is room for improvement. But, being a relatively novel experiment, with an uninitiated user group, it has served a very useful purpose in defining those areas that require modifications.

For the developing-country researchers, at least in this exercise, both the scientific content and the technique were viewed very positively. Expansion of the international data transmission network, however, is required.

For industrialized-country researchers, the technique was seen as useful, the vast majority would participate again, but the scientific discussions were viewed less positively. But, perhaps it is better to judge its scientific value after some time has elapsed. For instance, one participant attributed the conference discussion with being the catalyst for starting an interesting line of experiments many months after the conclusion of the conference. Furthermore, this conference has had an impact on this discipline as demonstrated by the number of spin-off activities: Computer Conference on Life Sciences on COM; Anaerobic Digestion Conferences on COM; MIRCEN On-Line Newsletter on COM and EIES; exploration of computerized links for a Nitrogen Fixation network in Asia, for the MIRCENs throughout the world and for a Latin American Brucellosis research network; computer-conferencing activities related to face-to-face conferences (Bioenergy '84, Biogas '85, GIAM VII in 1985); and computer conferences on criteria for modular transportable fermentation pilot plants and lignocellulosic pretreatment pilot plants.

Computer conferencing, although similar to face-to-face communication in several respects, is really quite different and should not be compared to it. Rather,

it should be perceived as a specific networking tool with its own advantages and drawbacks to be used to complement the use of other types of communicating. It is apparent that computers and data communication are increasingly becoming an integral part of governments, businesses, universities and research institutions throughout the world. Given this trend, the use of tools such as computer conferencing may allow researchers in developing countries to participate more fully in scientific developments of global interest. Hopefully, this computer conference and report will have facilitated this process.

CANADA